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SCIENTIFIC AMERICA

JANUARY 1926

SCULPTORS IN

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The Most Significant Forward Step
OTOR Design in a Quarter Century."

This motor has driven a boring mill without any attention for over nine months. Note the dust that covers the bearing housing. It is perfectly dry and can be blown off easily.

Announcing—

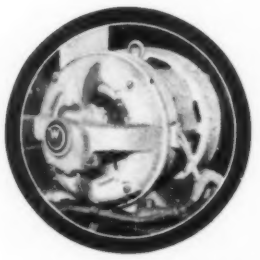
a motor bearing that has all the old, familiar sleeve-type advantages, but that is

Sealed

Oil can't get out—

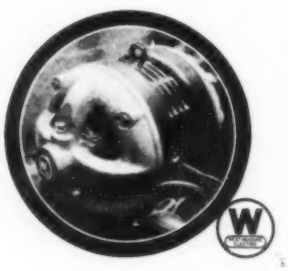
Dirt can't get in—

Removes forever the cause of motor bearing troubles.



The windings in this motor driving a machine tool are bone-dry. No oily film or coating was apparent on the motor windings even after ten months of continuous operation.

s motor is being used in severe ool service. When the pho- was taken it had been oper- r ten months without oiling. evel in the overflow plug had ered perceptibly.



This motor replaced one with conventional bearings that had given serious trouble due to burn-outs caused by oil leakage. No oil had been added even after eleven months of operation in this Ohio steel mill.

Westinghouse Motors Have **Sealed Sleeve** *Bearings*

Ask any operating or maintenance man what type of bearing is most satisfactory for general purpose motors and he'll tell you "sleeve-type bearings." They have a low coefficient of friction because the shaft "floats" on a film of oil. This oil film always separates the surfaces of the shaft and the bearing. And since the area of these surfaces is large, the bearing has longer life than is obtainable in other types. The oil film acts as a cushion, too, so that the effect of shocks, vibration, and jars which continually arise in service is reduced.

Moreover, the bearing is simple, and economical of maintenance and replacement. Its principles and operation are everywhere fully understood.

What Westinghouse has done is to perfect this bearing until it has all the merits of every other type of bearing, while at the same time retaining the old familiar sleeve-type bearing advantages.

Westinghouse has given it an air-tight housing that keeps the oil *inside*, where it belongs—and that keeps dirt, grit, and other foreign particles that may cause destruction of the bearing metal absolutely *out*. What Westinghouse has done removes forever the possibility of oil-soaked windings; they simply can't happen with **Sealed Sleeve** bearings; even vapor can't get out of the housing.

Exhaustive operating and service experience has developed other advantages which will interest you, and which prove conclusively that the motor bearings of the future will be **Sealed Sleeve** bearings. **Sealed Sleeve** bearings are available only in Westinghouse motors, and all Westinghouse motors for general use now offer their advantages.

ghouse

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BALL AND ROLLER BEARINGS

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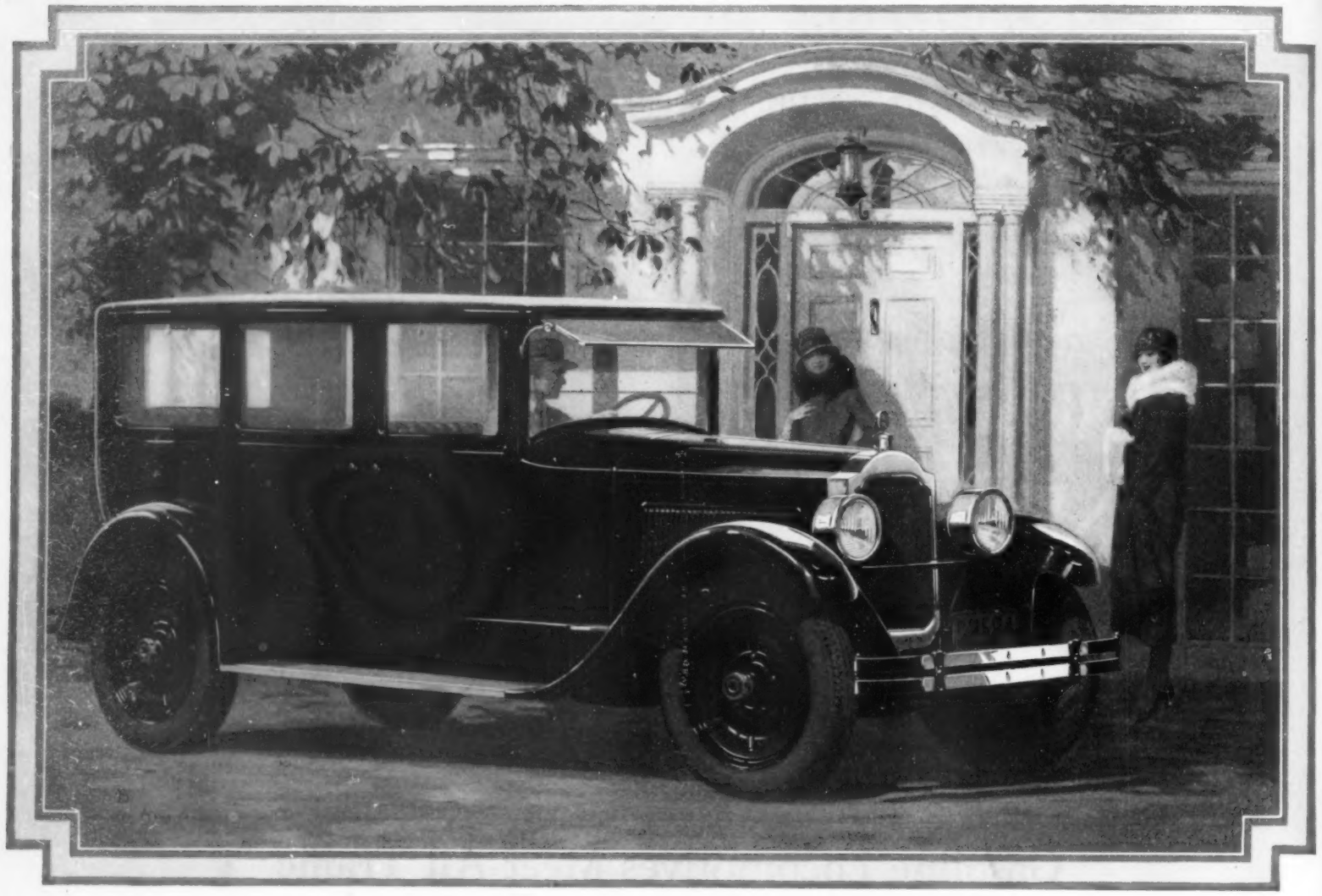

How Often Do You Buy A War Tax?

EACH time you buy a motor car you pay for five things in which you never can take a ride.

These are: war tax—freight charge—factory's profit—dealer's profit—salesman's commission.

Once every five years or more is often enough to afford yourself the luxury of such purchases.

Those who buy the Packard Six expect, on the average, to keep their cars more than five years, spending the minimum in war tax and other outside charges.

Packard encourages its owners in keeping their cars, through retaining the beauty of Packard lines and in announcing no yearly models. It is now more than ten years since Packard offered yearly models.

The most recent evidence of Packard's interest in its owners is the chassis lubricator and motor oil rectifier, found only in Packard cars. Together they double the life of the car.

The Packard Six Five-passenger Sedan is illustrated—$2585 at Detroit. Packard Six and Packard Eight both are furnished in nine body types, four open and five enclosed. Packard distributers and dealers welcome the buyer who prefers to purchase his Packard out of income instead of capital.

PACKARD

The PACKARD SIX — Ask the man who owns one

ASK THE MAN WHO OWNS ONE

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, JANUARY, 1926 EIGHTY-SECOND YEAR

SHIBBOLETH

IN ancient times the Greeks and Romans consulted their oracles and, whatever the portend of the omen, were guided thereby.

Today, we read of some scientific discovery, perhaps an invention which is heralded as portending vast improvement in one of the necessities of life, or some new means of checking a pernicious disease, or a keystone step in the advance of science. What is the truth of it all? Is it as it is claimed? Is there reason to believe its development will fulfill the promise? It is just this that we aim to give our readers—the facts of today's accomplishment as a portend of the development of tomorrow. So we have adopted the shibboleth; "The magazine of today and tomorrow."

SIGNIFICANT

SOMETIMES money speaks very precisely where words only speak vaguely. Here is an amusing case in point, taken from an editorial in the well-known *Journal of the American Medical Association*, the professional magazine read by the majority of the American physicians. It seems that one of the insurance companies makes a special feature of insuring doctors—and other healers that are not regular doctors—against damage suits for malpractice. Thus it costs an M.D. $12.50 a year to insure himself against such suits to the extent of $5,000. But it costs the practitioner who uses the E.R.A. (Electric Reactions of Abrams) methods $50 to get the same protection.

Now the insurance company is no stickler for sentiment and its rates are based on definite, past experience—nothing else; and certainly not on guess-work. In other words, they know pretty closely how great their "risks" are. Twelve dollars and fifty cents against $50 is four to one.

Money does talk very plainly, sometimes!

NOISE

THE good people who have banded themselves together in the effort to reduce unnecessary and intolerable noises in our cities should be pleased to note that the growth of electric welding may on some future day—and the sooner the better—get rid of the machine-gun rattle of the pneumatic riveter. Those of us who work in cities know what it is to have one's office bombarded by the staccato voice of this machine. The typewriter, whose rattle is sufficiently distracting, is entirely submerged when the steelwork of an office building begins to rise heavenward on an adjoining lot. The hope of the future lies in electric welding.

In This Issue

Are the Continents Drifting?

The continents are made of lighter rocks that float in heavier rocks beneath—this is an established geological principle. That these continents also drift to east and west is the hypothesis of an Austrian geologist. At first, other geologists scoffed at this hypothesis—now they discuss it seriously. Will they eventually accept it? Page 8.

The Indian as a Sociological Problem

Few of us are well informed on the subject of the present political and economic status of the American Indian. Few of us know of the long period of hardship and deprivation that has fallen upon this one-time majestic race. You will be interested in their story on page 5.

Spirit Mediums Fail in Test

Is it possible to communicate with the dead? Through a simple test, conducted by Dr. J. Allen Gilbert and with our assistance, it would seem that the answer to that question is in the negative. Page 13.

Your Ancestors in Tropical England

A half million years ago in Yorkshire they hunted the sabre-toothed tiger with flint weapons. This was before England was an island. Here is a story which Mr. J. Reid Moir reads from flint flakes. Page 20.

Comfort from Your Motor

The reduction of vibration and friction constitute two of the most important advances in motorcar development. On page 14, Mr. H. W. Slauson, automotive authority, tells of the vast improvements in 1926 engine design.

MORE THAN 175 PICTURES

Complete table of contents will be found on page 72.

For Next Month

Ho! Would-be Telescope Makers

The precious data that has been unavailable for so many years—how to make reflecting telescopes and their marvelous concave mirrors—will be told with numerous special drawings by R. W. Porter, veteran telescope maker.

Can We Feed All Our Immigrants?

The more people who come here the more food and the more cattle must be produced to feed them. But, as they fill up the country the less land we will have available to raise foodstuffs. Dr. E. E. Free discusses this vital question.

What Is Life?

To this question, perhaps the greatest of all scientific questions, man must answer, "We are still in the dark." But there are signs of dawn advancing. Dr. D. T. MacDougal, of the Carnegie Institution, has succeeded in duplicating some of the mysterious life processes in an artificial plant cell.

Other articles on Mapping Alaska; Treatment of Bronzes; Conservation of Our Soil; Snow Flowers; Radio; Astronomy.

MORE THAN 175 PICTURES

¶ ***Do you believe a two dollar bill is unlucky? Some people think so. If you are one of them try this formula: Put it in an envelope and send it to the Scientific American. For half a year you will think yourself mighty fortunate every month.***

TELESCOPES

EVIDENTLY we have "started something." Everybody wants to be a telescope maker. We are bombarded with letters requesting, supplicating, demanding that we publish instructions for making a telescope of the kind shown in our November issue. Every mail brings in more letters.

The first instructions, telling where to get materials and just how to proceed with the work, will reach you in the February issue, out January 20. More will follow in the March issue.

WHICH?

TWO factions of scientists are at odds. One faction says civilization started in one place in the world and spread from this center. They place it near Egypt. Sun worship, ear-piercing, tattooing, pyramids, irrigation, similarity of art, and a long list of even more peculiar manners and customs argue for a common origin, they claim.

The other faction says: "No. These similarities of manners and customs and superstitions simply show that the human mind works about the same everywhere. Given two or several isolated peoples, as time goes on they will develop similar peculiarities because there is an *inherent tendency* in man to develop culture by the same stages and in the same way." They call this tendency "psychic unity."

The leader of the minority group is Professor G. Elliot Smith of the University of London. He has written a book called "Elephants and Ethnologists," reviewed in this issue, to prove that the remarkable civilization of the Maya Indians was only a transplantation from the Old World center of culture dispersion.

Orthodox science says Professor Smith is mistaken—the Maya culture was originated here, by the Indians themselves independent of the Old World.

OMNISCIENCE

IN the history of the world there have been a handful of men credited with holding in their own craniums all the knowledge there was. Aristotle was such a one. Lord Bacon who "took all knowledge for his province" was another. Dr. Johnson was another.

And today? We have men of tremendous intellectual power, men who know many things of which their forebears never dreamed. But for one man to know everything that all of the rest of us know? Well, there recently was compiled a "World List of Scientific Periodicals." It shows more than *24,000* periodicals publishing the results of scientific research.

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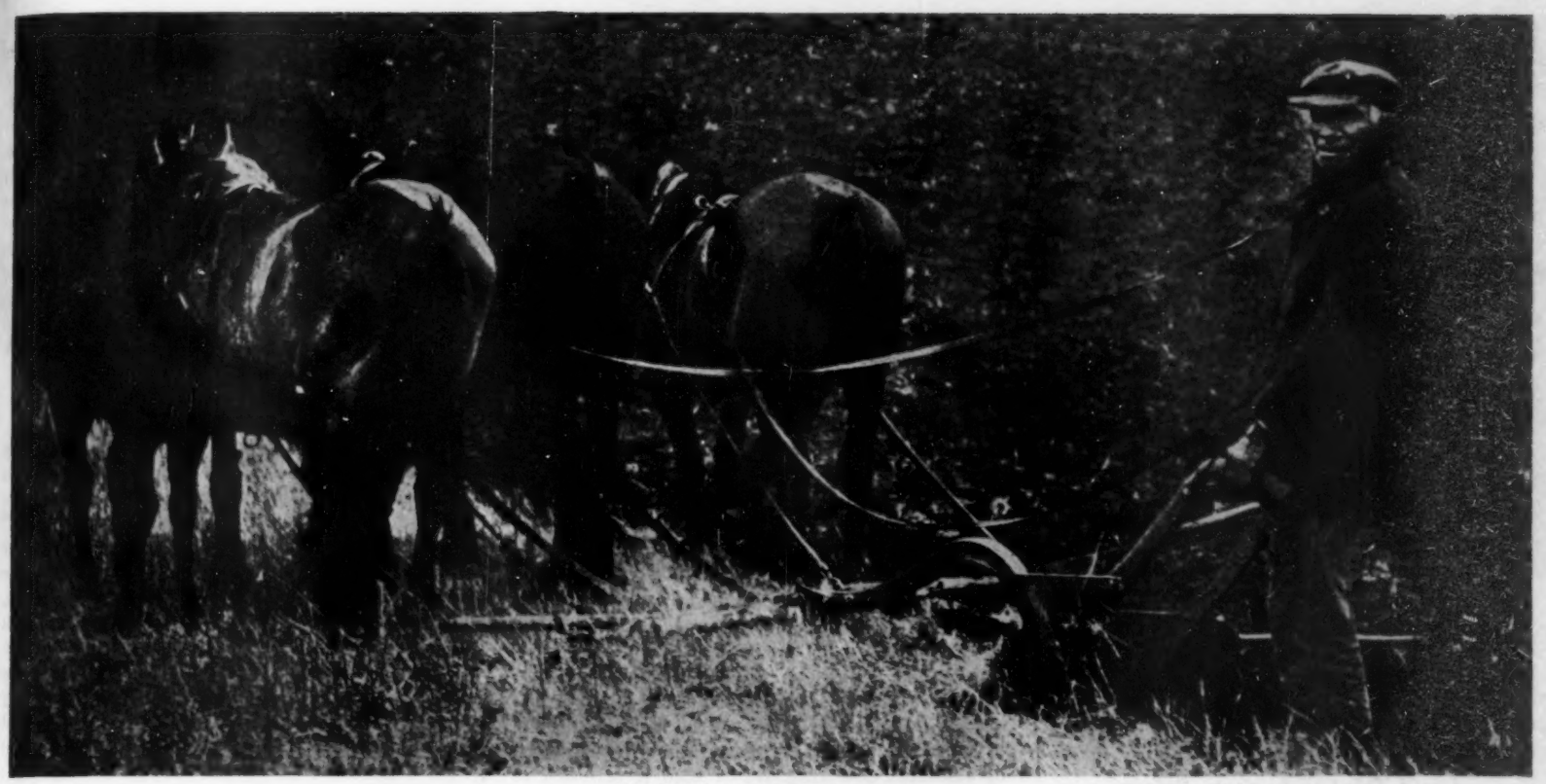


THE INDIAN WAR-PATH OF 1925

The Tragedy of the Indian

The Story of Indian Wrongs as Written in the Records of Congress

ONLY the law of change is changeless. Half a century ago no one viewed the Indian problem in its purely scientific aspects. Even now, to the ordinary person it is one of mere sentiment demanding, perhaps, a somewhat more charitable attitude on the part of the nation than in the past, periodic appropriations, and an annual report from a bureau of the Department of the Interior created in 1846 to deal with the aborigines. Now and then the country is regaled with some story in the press about an Indian and an oil well. There have been many stories too about individual Indians in the late war. Some of us—a surprisingly few—have heard that full citizenship was conferred on all the Indians in 1924, and in a vague way it is known that the Indians we now and then see in the wild west shows and the motion pictures represent a past era. From all these things we conclude—also in a vague way—that the Indian problem is no more.

Revision of Indian Policy Necessary

Presto! The situation changes in a twinkling. Certain Indians in widely separated sections—the eighteen California tribes, the Yankton Sioux of South Dakota, the Six Nations of New York—employ as counsel Colonel Jennings C. Wise, to litigate certain remaining rights.

With a traditional interest in the Indians that had been aroused by a recent experience with them in the late war, Colonel Wise examines the cases submitted to him. He sees that in all of them there is a great and common underlying principle. The Indians are no longer merely the political wards of a guardian Government over whom Congress is free, as in the past, to exercise an almost unlimited plenary political power. When they were enfranchised, the nation became a trustee at law of their property. That principle he sees must be established, and so he presents to Congress a plea for the Indian citizens of the United States which is designed to arouse the country to a recognition of the fact that, with the change of status of the Indians from that of mere wards to citizens, a revision of the entire Indian policy of the Government becomes necessary.

The plea is printed and widely distributed. Its author, declares Philip Alexander Bruce, is to be congratulated "in the name of national decency," for he has lifted the Indian question above the plane of sentiment and caused it to take its place before Congress as a sociological and political problem of the first rank.

A Problem That Must Be Solved

Incontestably, the greatest blot upon the Government and people of the United States is their treatment of the Indian. It is a story of brutal tyranny, broken pledges and cynical contempt. Strong words? Yes. But read this article by an authority and you will have to confess that they are true. So far as may be, Congress must atone for the past by swift and adequate legislation for the unhappy descendants of those proud races whom our forefathers dispossessed.

The Indian policy of the nation is, perhaps, the greatest reproach to the American people. Although the Indians, measured by European standards, were the most moral people known to history, the colonial Englishman's church deemed them the "spawn of hell," to be extirpated in the spirit of the Old Testament. Desirous of their lands the frontiersman invented the useful fiction that a people who had occupied definite tribal domains from time immemorial were nomads without attachment to the soil. Thus, when, in 1776, the United States assumed political jurisdiction over these former subjects of the British Crown, the Americans along the frontier deemed the rights of the Indians and the buffalo to be on a parity. Said Brackinridge, a frontier editor, in 1782: "So far from admitting the Indian title, I would as soon admit that of the buffalo." Again: "the animals vulgarly called Indians, being by nature fierce and cruel, I consider their extirpation would be useful to the world while entirely honorable to those who would effect it."

With such a view extant among the so-called civilized whites, it was not unnatural that the Indian should have become fierce in the defense of his lands—and that the idea should have gained credence that "the only good Indian is a dead Indian."

Constitution and Statutes Ignored

In vain Washington, who knew his fellow countrymen and was not deceived by them, sought to prevent the massacre of the Indians and to protect them in their admitted rights. The Constitution itself forbade the acquisition of their lands save by United States treaties. New York ignored the Constitution and the statutes. Georgia, with the tacit consent of John Quincy Adams and Jackson twice nullified the mandates of the Supreme Court, threatening a resort to arms to prevent their enforcement; while the people of Alabama threatened to secede from the Union if Indian statutes were rendered effective. Under Jefferson, Madison and Jackson, dependent as they were for their political support upon the "new democracy" of the frontier, the Buffalo Party had free play.

In 1824 Monroe, hearkening to the wisdom and justice of Washington and Marshall, timidly pro-

posed to give the Indians land individually in order that they might be emancipated from their aboriginal state and be enabled to compete in the economic order of civilization. The nation would not have it. He then proposed their concentration in the Indian Territory. This was partly effected under Jackson as the means of driving them, despite the Supreme Court, from the white man's path. Even there they were molested and abused.

Then came a veritable reign of terror for the Indians of the west. Along the Oregon Trail and in the gold fields of California and the Black Hills they were destroyed like the buffalo. The Californians and Oregonians demanded that they be removed. Congress passed acts providing for the negotiation of treaties with the Indian tribes of the Pacific coast in which reservations were promised them for the lands surrendered. Pending the ratification of these treaties they were induced to remove. Political influence prevented the ratification by the Senate of the treaties. Thus deceived, dispossessed, betrayed, a quarter of a million helpless people, who had been partly civilized and Christianized by the Spaniards, whose rights were secure under the laws of Spain and Mexico, and whose rights had been solemnly guaranteed by the United States in the treaty of Guadalupe Hidalgo, were harried from place to place, massacred at will, and left to become vagrants upon the earth. Today, they are homeless and dependent upon charity.

Grant Tried to Institute Reforms

In addition to the gold-seekers another enemy was soon to appear. In 1850 Congress adopted the policy of granting western lands to corporate interests in order to promote the construction of the transcontinental railroads. To this end, grants aggregating 155,000,000 acres of land with slight regard to Indian rights were made. Then came the Homestead Act of 1862 which caused the remaining Indian lands to be deluged with white settlers. The Indians of the east and the Pacific coast having been entirely dispossessed, now came the turn of the plains Indians. In all, it was necessary for the guardian Government to wage over fifty official wars against its wards during the first century of its existence in the civilizing process which it brought to bear, although there is not one instance in which the Indians sought to defend themselves until after protection had been denied them. During this same period the Indians north of the Canadian border, protected by their Government, remained in peace.

It was a harsh tutelage which the Indians of the United States underwent. It was not until Grant became president that the responsibility of the nation was recognized. At his instance the Indian Homestead Act of 1875 was passed and steps taken

Courtesy of Glacier National Park

TEEPEES OF BLACKFEET INDIANS

Soon this picturesque type of home will no longer exist

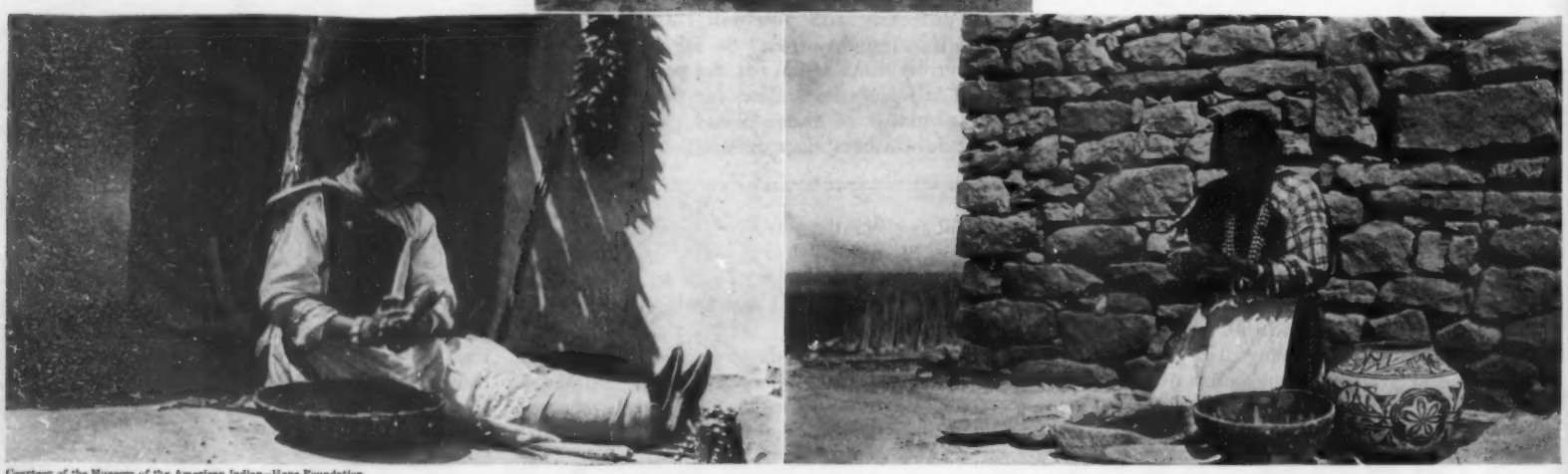
culminating in the General Allotment Act of 1887 —measures designed to absorb the Indians in the economic and social order of the political society of the nation. That absorption was to be expedited by education and allotment of land in severalty to the Indians. Those who took allotments were to become citizens. Inadequate provisions for Indian education having been made, allotment has naturally proceeded slowly. Yet, in 1917, the Indians were called upon to fight for the nation. Responding with a spirit not equalled by that of the white or black citizens, and without regard to citizenship, they furnished 17,000 soldiers. Among all the Indians less than 250 sought exemption. As a reward they were enfranchised in 1924; but today, half a century after Grant instituted his wise reforms, over 150,000 tribal Indians remain enslaved to the outworn economic and social systems of an aboriginal race. Far more has been done for the Negroes in sixty years, for the Filipinos and Hawaiians in thirty years, than has been done for the Indians in a century and a half. Although the political massacre of the California Indians is, perhaps, the most scandalous incident in the history of the United States, not an official hand has been raised to help them, while the efforts of the Indian Board of Cooperation of California—a private philanthropic association—have so far proved abortive.

Appeals to the Government Unheeded

It would be useless to attempt here an accounting as between the United States and its Indian wards for the purpose of determining whether or not the compensation paid for their lands has been "ample." Suffice it to say that if the acreage acquired by the United States, or the political guardian, from the Indians, or its wards, were placed in one column, and the price actually paid therefor in another, it would require a stretch of the imagination to construe the purchase price as "ample," or one that the Indians had in fact voluntarily accepted. History shows that the actual course of the Government of the United States in dealing with this dependent people has ordinarily embodied the following steps: 1. Disputes over Indian lands between the Indians and white settlers; 2. local violence to the Indians by white intruders; 3. appeals to the Government by the Indians for the protection of their rights; 4. failure of the Government to provide, or the provision of inadequate protection; 5. efforts on the part of the Indians toward self-protection, and sometimes retaliation for wrongs done them; 6. official military restraint and often chastisement; 7. so-called treaties of cession at a price fixed by the guardian Government, sometimes procured fraudulently by shrewd negotiators and undue influence upon tribal representatives, sometimes compelled by threat of force, seldom voluntary.

Such, in brief, is the cold outline of the national history with respect to this dependent people. Deny it though we may, the facts are written in large letters in the debates of Congress and the records of the fifty-odd wars the nation has waged against this helpless race.

The past is gone forever. It is the present situation of the Indians that requires to be corrected. The facts of sociological importance are that in 1492 —when the White Man assumed responsibility for the Red Race—there were, according to the ethnological experts, 918,000 aborigines within the pres-



Courtesy of the Museum of the American Indian–Heye Foundation

ZUÑI WOMEN AT WORK

LEFT: *Taking corn from the cob.* CENTER, ABOVE: *Kneading bread and making it ready for the baking.* RIGHT: *Preparing clay for the making of pottery*

E. M. Newman

HOW THE WOMEN OF ACOMA CARRY BURDENS

The Indian village of Acoma is situated on top of a high mesa in western New Mexico. The three-story houses are terraced back from the streets

Courtesy of the Museum of the American Indian—Hyde Foundation

HOW THE BIG CHIEF PAINTS HIMSELF

The primitive Piutes of the plateau country still paint their bodies. It is doubtful, however, that the papoose, when he grows to manhood, will follow his father's practice

ent continental limits of the United States. In 1910 there were 403,000 so-called Indians of all degrees of admixture—a decrease of nearly sixty percent in four centuries. We know the cause of this decrease —wars, wholesale murder, small-pox, tuberculosis, sexual diseases, whiskey, attendant dissipation, lowered vitality, starvation. Removals account for a very small part of it. In 1920, however, but a decade later, the census showed that there were but 265,683 persons in the United States who claimed to be Indians, while the Commissioner of Indian Affairs in 1924 reported but 320,497 legal Indians of all degrees of admixture, and 162,602 full bloods. Query? What became of the 137,317 Indians who vanished between 1910 and 1920? How is the discrepancy between the census figure for 1920 and the number of legal Indians in 1924—a difference of 54,814—accounted for?

Plainly, the Indians are amalgamating at a very rapid rate with the whites. The returns mentioned are conclusive that a sixth of all the Indians of whatever degree of red blood, or persons who claim to be Indians for purely legal reasons, are indiscernible as such, and must claim to be Indians to be distinguished from the whites.

Reservations Have Become Prisons

By reason of the lowered vitality of the Red Race in consequence of its experience of the past four centuries, the average Indian seems to be physically inferior to the average white man. Yet, the average half breed does not appear to be physically inferior to the average Indian; his mental capacity is inferior to that of neither race; his intellectual growth depends upon environment and opportunity.

There can be little doubt that morally the red man is the equal of the white. In the late war the psychiatric test was applied to thousands of all four races—white, red, yellow and black. The red man, unlike the Asiatics and Africans, showed a greater power to resist mental strain than whites. An eminent authority, who knows the red race, insists that this superiority is due to the spiritual poise that has come to it from a philosophy of life that makes God not an anthropomorphic deity but a universal, omnipresent, benignant force in nature, giving to the Indian an ability to stand fast, an integrity, a fundamental something which lies at the roots of his race, a something in human character to which faith may be pinned, as well as his characteristic staunchness, dignity, self-respect, and strength of mind.

The foregoing conclusion affords the clue to the solution of the sociological problem of the Indians. To insure the economic is but to insure the social welfare of a people. If the remaining pure Indian blood is an inevitable national admixture, common sense dictates that it be protected in order that it be not debased and that with it an inferior strain be not admitted. Without regard to justice and the due of the Indians, therefore, it goes without saying that for the good of the white man no Indian should be denied the highest form of free education of which he is capable, and that rudimentary education, at least, should be enforced upon all Indians. Medical aid, hospitals, and asylums for orphans, the blind, aged, infirm, homeless and insane, should be freely placed at their disposal and no want on their part suffered to exist in these respects.

We now come to the purely political problem that confronts Congress.

The Indian social unit is the tribe. Half a century ago the remnants of the tribes were confined to reservations as the only possible expedient to save them. Under the existing circumstances the reservation policy was sound, since reservations were no more nor less than refuges. Viewed in any other light the system would have been unjustifiable. Nor was it ever assumed by President Grant that reservations were to be more than the medium of transforming the remaining hard-pressed Indians from their aboriginal state to the economic order of the nation. In order to transform an aborigine it was essential, therefore, that he be given an estate adequate to enable him to abandon the communal society of the tribe. To this end the Indian Homestead Act of 1875 and the General Allotment Act of 1887 were passed. Under both, he could, by his own act, acquire an estate of which the Government stood as trustee in behalf of himself and his posterity, protecting him against his own limitations and the wiles of the unscrupulous whites. Today approximately half the Indians retain their tribal relations, still speaking the language of their great-great-grandfathers. Herded like the few remaining buffalo on reservations which now merely serve to incarcerate them in the aboriginal economic and social order, from refuges the reservations have become for them dark prisons from which the sunlight of civilization is excluded by the outworn governmental system.

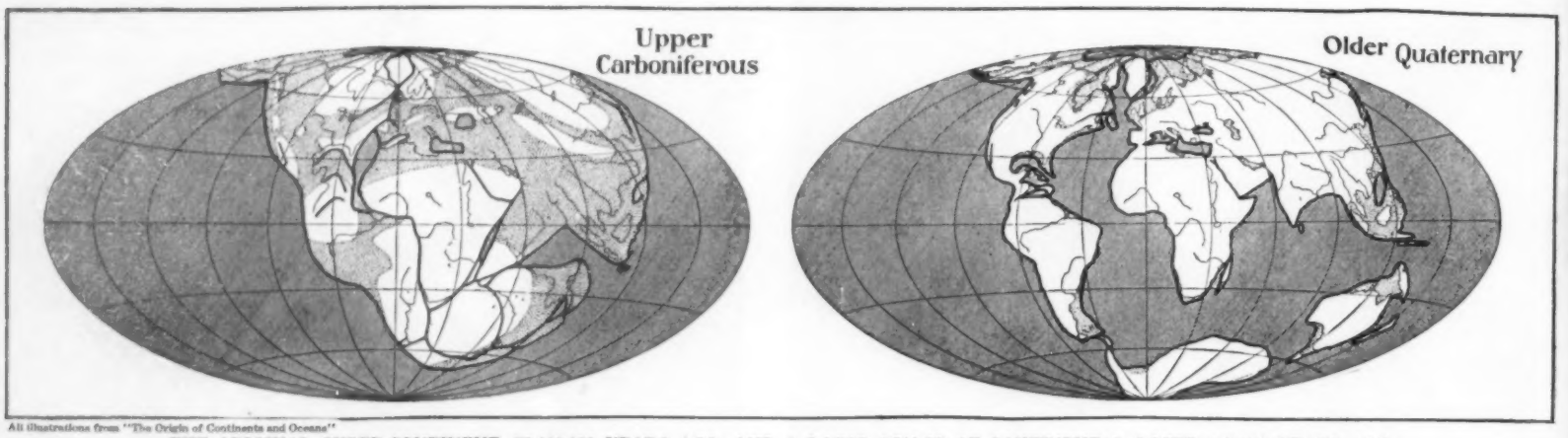
E. M. Newman

ACOMA INDIAN MAIDENS

The peculiar hair dress indicates that they are unmarried. Upon marriage, the hair is worn in a long sworl

Their Needs Must Be Studied

Plainly the old political system must be revised. How should this be done? Not by the passage of new and disconnected statutes. The problem must be solved in an intelligent and scientific way. First, the needs of the Indians, which vary greatly with localities, must be studied. This can only be done, as pointed out by President Cleveland, by a body of able, unprejudiced men, similar to the Dawes Commission of 1893. On the Commission should be placed only men of vision and ability—trained sociologists, economists, and political scientists. It should include several Indians in order to afford to its white members a lens of understanding, through which the true nature and aspirations of the Indian may be viewed in a sympathetic way. Upon the findings and recommendations of such a jury alone can Congress devise the necessary laws to put into effect a policy designed to solve the Indian problem. Until the information that such a commission can acquire is forthcoming, let the well-wishers of the Indians direct their efforts solely to the support of its work and cease to urge upon Congress special legislation that alone can not accomplish the emancipation of the race. For that an entire new and well coordinated political system is necessary.



All illustrations from "The Origin of Continents and Oceans"

THE ORIGINAL SUPER-CONTINENT, 70,000,000 YEARS AGO, AND A LATER PHASE OF CONTINENTAL DRIFT, 500,000 YEARS AGO

Although the present continental outlines are roughly indicated on the left-hand map, these lines did not actually exist on the original super-continent. The map on the right shows the comparatively narrow Atlantic Ocean of the early part of the glacial period. India, once twice as long as now, was "telescoped" into Asia, forming the Himalayas

Are the Continents Drifting?

A New Theory Which Is Arousing Controversy Among Scientists

By Albert G. Ingalls

SUPPOSE a giant, standing in the Pacific Ocean, should place one hand against North America and the other hand against South America, and push both continents eastward across the Atlantic Ocean until they came up against Europe and Africa. If you will look at a map of the world, such as the one shown below, or better still, a globe, you will find that the two Americas would fit the irregular curve of the opposite shores of the Atlantic almost as neatly as a ferryboat fits its slip. They would fit almost like the parts of a jig-saw puzzle.

This seems to be a remarkable coincidence.

Is it only a coincidence?

Professor Alfred Wegener, of the department of mineralogy and climatology at the Austrian University of Graz, says it is not. Millions of years ago, he says, the two Americas, as well as Europe, Asia, Australia, Antarctica and all the islands of the present-day world were one continent, centered around Africa.

Tidal forces—the attraction of the sun and moon for the earth's solid mass (not ocean tides) broke this super-continent up, and the pieces slowly dispersed in various directions, like the blocks of a great, flat cake of floating ice which is broken up by the waves. Some of these pieces, the present continents and islands, are drifting yet, gradually moving away from the nuclear Africa.

A Theory Under Heavy Fire

This theory is startling. To many it seems absurd. It may prove to be erroneous. It may gain final acceptance among geologists. At the present time it is strongly heterodox, but there is something about it that seems to captivate the interest of scientists. They have given it a fair hearing and it is being discussed seriously in various scientific journals. But it will remain under judgment for at least ten years. About 1935 there will be a way to put it to a strict test. I shall come to that later. In the meantime the reader should not be too quick to condemn the Wegener theory, for, like many other theories that have gradually overcome adverse resistance, there is more to it than one might think at the start.

How could the continents actually drift? Are they not attached to the solid heart of the earth? In fact, are they not an integral part of it? To explain this we shall have to go back a way.

For a long time the geologists, geodesists and geophysicists have known that the earth is solid all through, not molten according to the early belief. Earthquake waves arriving through the earth show us this fact.

The central core of the earth is probably a mixture of nickel and iron. Suess, a famous geophysicist, therefore named this core material *nife* (Ni, nickel; Fe, iron—chemical symbols).

LIKE A JIG-SAW PUZZLE

The heavy, black lines represent the real edges of the continents, the shallow continental shelves being a part of them

Surrounding this spherical core of *nife* is a deep layer of material which Suess called *sima*, its chief constituents being silica (Si) and magnesium (Ma). The heavy rock, basalt, is a kind of *sima*.

Third and uppermost comes the lighter *sial*, forming the continents and islands, but lacking in the sea-beds, where the *sima* layer lies bare.

The core of *nife* we can forget in this consideration. The *sima* and *sial* we shall need to remember.

The *sima* layer is heavier than the *sial* of which the continents and islands are composed. Therefore the *sial* lies on top. Basalt has a specific gravity of about 3—that is, it is three times as heavy as water, volume for volume. Granitic and gneissic rocks, which compose most of the land surfaces, have a specific gravity of only about 2.9. The floating blocks of *sial* average about sixty miles thick.

It is hard to think of solid rocks as "floating" on other solid rocks. Rock, however, is viscous, solid as it appears. True, it is not as viscous as things we ordinarily call viscous—motor oil, syrup, tar—but in a relative sense it is viscous.

In laboratory experiments, rocks placed under enormous pressure have been made to flow within fairly short lengths of time. Given more time, less pressure will likewise produce a flow. Even under slight stress some rocks bend. We have all seen thin stone slabs that have sagged at the center.

Another analogy, familiar to geologists, is that between the rocks of the earth's crust and common pitch. You can press your whole weight against cold pitch without deforming it. Yet if you place a fifty-cent piece on its surface and leave it there a while, you will discover that the coin has gradually worked its way down into the pitch. Like pitch, rock will flow if there is time, except that it needs much more time for the same amount of pressure.

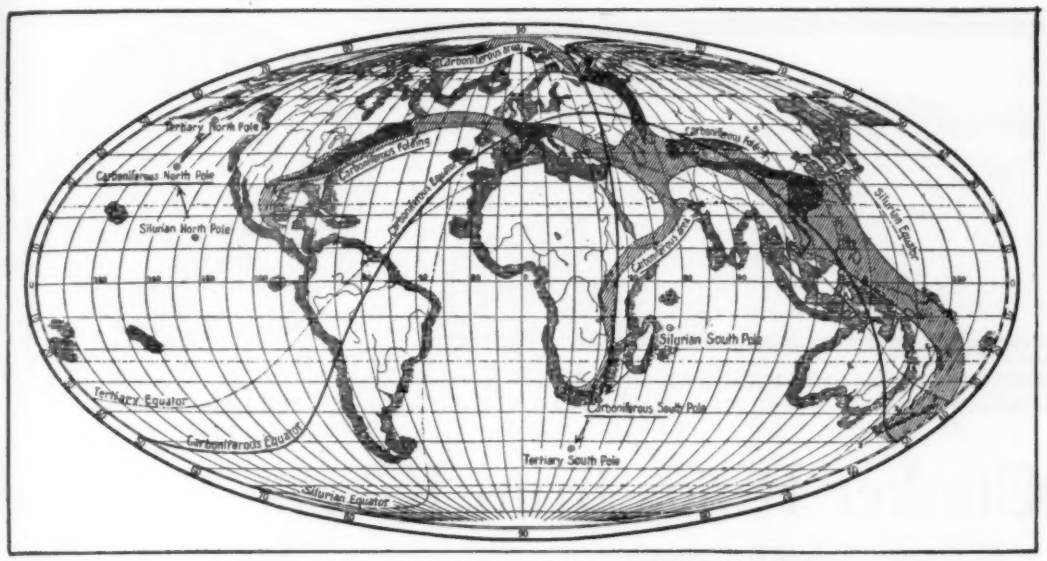
The Continents Are Afloat

If you conceive the continents as blocks of *sial*, some sixty miles thick, based on a heavier layer of *sima* beneath, and if you know that rocks actually do flow under pressure in long periods of time, you will have no difficulty in imagining how the present continents of the earth might have drifted in different directions like the broken cakes of an ice-floe.

The continents must not, however, be conceived as resting on top of the underlying *sima*, but as floating *in* it like a piece of toast in a rarebit. That is, the continents are nearly as dense as the *sima*, therefore they float low, with only about three miles of vertical projection above the ocean bed.

Another point over which we may hesitate is the continental shelf. Where *is* the actual edge of the continent? In school we drew maps (some of us traced them) and thus we learned the geographical outlines of the continents. Now we must forget these mere geographical outlines and learn the revised physiographical map showing the continental shelf as an integral part of the continents. In some places we shall find that there is very little difference. In others there is a great difference in the physiographical outlines. Note Wegener's map.

Florida, for example, extends many miles to the southeast. So does South America. Europe acquires



HOW THE POLES AND THE EQUATOR MAY HAVE SHIFTED

Fossils prove that there have been glacial periods in the tropics, and tropical climates in our arctic regions. To account for this, Wegener assumes a shifting of the poles. Thus the world's coal deposits could have accumulated near the tropics

WAS THERE ONLY ONE GLACIAL CAP?

When both continents are brought together, the outermost terminal moraines of the ice cap (dotted line) join up evenly

a large wing extending northwest, and the British Isles are merely a little patch on that extension. Most of the area of sea between the East Indies is an integral part of Asia, but the equally shallow area surrounding New Guinea is a part of Australia.

All of these extensions are really slightly submerged plateaus, less than 600 feet beneath the surface of the seas. They are a part of the continental shelf and are therefore a definite part of the continents. All this is common physical geography, and so we must not accuse Wegener of fixing up the continental outlines to make them fit his theory.

Now let us go back in geologic time to the juvenile earth and try to get some idea of the sequence through which its continents are supposed by Professor Wegener to have passed.

For hundreds of millions of years there was only one continent, or super-continent. Life existed on it and evolved practically as our geologies teach, except that instead of existing on separate continents it was all on one greater continent.

Thus, early in the Jurassic Period, perhaps 40,000,000 years ago, Antarctica, Australia with New Zealand and New Guinea, India, and South America lay adjoining South Africa; Asia and North America were further away from the center, but were still a part of the single mass.

In the course of the Mesozoic Era (Age of Reptiles) and the Tertiary Period (Age of Mammals) this great area broke up, progressively, into smaller blocks of land, and these began a dispersive drift.

What broke them up? What dispersed them? Here Wegener's theory, which he prefers to call "the theory of the displacement of the continents," is a little shaky. Other scientists have belabored it strenuously because no cause that seemed sufficient to account for the break-up and drift has been given. Dr. Harold Jeffreys, brilliant Cambridge University geophysicist and author of a noted book entitled "The Earth: Its Origin, History and Physical Constitution," refuses to accept the Wegener theory "unless forces enormously greater than any yet suggested are yet available."

Sometimes, however, science makes progress by building up a structure which is out of logical sequence. Thus, "if adequate geological proof of continental drift is forthcoming," says Dr. G. W. Tyrrell of Wegener's theory, "geologists will believe it despite any assertion of its physical or mathematical impossibility." A cause for the hypothetical drift may be found later.

A Way to Test This Theory

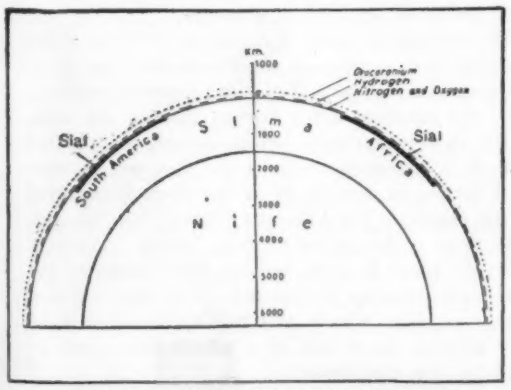
In Cretaceous times, South America broke away from the super-continent and drifted westward until it met with the strong resistance of the well-cooled Pacific Ocean floor. The drifting force continuing, the western margin of South America was crumpled up, and we have the Andes range of mountains.

North America remained attached to Greenland, and Greenland to the Old World, at least by its northern half, until comparatively recently, perhaps only a million years ago. Now that it has cast off, Greenland is thought to be moving away from Scotland at the rate of 60 to 120 feet per year. It ought, then, to be easy to test this Greenland drift. In 1823, in 1870 and in 1907 some determinations of longitude were made in Greenland, but this was accomplished by the lunar method which is not absolutely precise. Can these figures be trusted? In any case, they will not be trusted.

What is planned includes not only Greenland, but many other points in the world. Last year, at a meeting of the world's geodesists, it was voted to establish a world network of longitude determinations obtained by radio time signals, a method which is precise. Ten years hence, a redetermination will tell whether the continents are drifting or not. Radio alone makes this fine degree of precision possible.

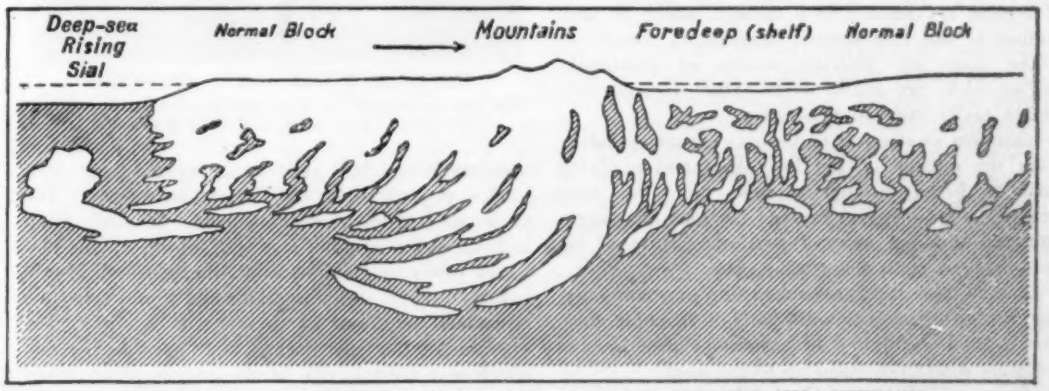
The Wegener theory includes too many details to cover in this space. There are interesting check tests which show how several hypothetical former land bridges between some of the continents, which geologists have always had to postulate in order to account for a close similarity between widely separated fossil fauna and floras, are done away with when the continents are considered to have been in actual contact during most of the evolution of plants and animals. There are analogies between the rocks of Brazil and Africa. There are explanations of the hitherto inexplicable distribution of the evidences of geologically ancient glacial periods. These are explained in convincing, even if rather one-sided, detail in Wegener's recent book, "The Origins of Continents and Oceans" (Dutton), a book of about 200 pages, well suited to the general reader.

Wegener's theory of continental displacement is frankly an hypothesis. It is more than a "guess," because it is fairly well controlled by partly established principles of geophysics, a science about which we know, however, comparatively little at the present time.



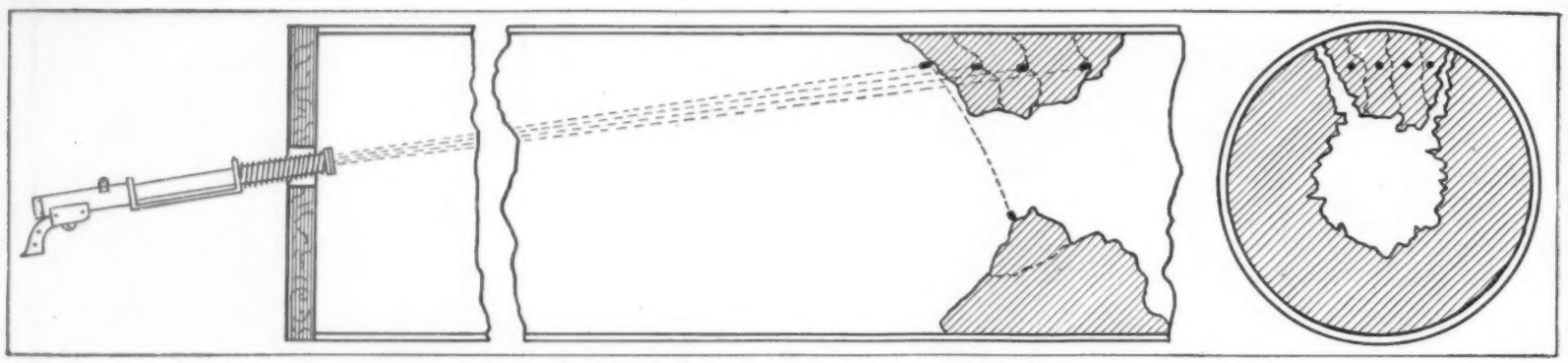
THE CONTINENTS ARE RELATIVELY THIN

This cross-section of the earth is diagrammatic; actually no such uniform conditions are believed to exist



HOW THE *SIAL* OF THE CONTINENTS MAY ACTUALLY JOIN THE *SIMA* BENEATH

The transition is gradual and non-uniform. Note that mountains indicate added thickness of sial, required to buoy them up; while shallow underwater areas require less thickness for support. This is according to the principle of isostasy



LONGITUDINAL AND CROSS SECTIONS OF THE KILN

The left view indicates the obstruction to be removed and the method of placing the shots. The right view shows the method of cutting a keyway out of the obstruction

Shooting Clinker Rings from Kilns

By Captain Edward C. Crossman

AT FIRST glance this may seem like a story better adapted to a sportsman's magazine than one of technical persuasion. Experienced persons tell me, however, that the variety of shooting touched upon in this article has not the least connection with sport.

It appears that the gentlemen engaged in the pleasant and easy business of producing cement from lime rock and other things are troubled with the constant formation of clinker rings in the kilns which affect the flow of the clinker when they are allowed to build up to any extent.

Removing one of these rings, without giving the kiln plenty of time to shed its calories, has been impossible, and letting a kiln cool down sufficiently to work on the inside, produced much grief in the cement business because of the time lost in the cooling off and heating up process. Various experiments in removing the rings without cooling the kiln proved failures.

Square-nosed Bullets Used

One company, the Dewey Portland Cement Company, of Dewey, Oklahoma, reported that it had to shut down each kiln once or twice a day to bar out the clinker rings, with a dozen men on a water bar and requiring a half hour's time. In turn, this required firing the kiln a half hour without feed to restore the proper temperature, while the constant cooling and heating did an unknown amount of damage to the brick.

These kilns are pleasing tubular contrivances, roughly ten feet or so in diameter, with fire-brick lining and an internal heat several degrees higher than the reputed temperature of the brazen hinges of Hades. In them the two principal components of cement are burned to a clinker, which is later ground to the fine cement familiar to commerce.

The rings are glowing masses of practically molten rock, not unlike lava. Once formed they do not easily yield to persuasion.

Inasmuch as removal of the ring meant operating from the outside of the fiery kiln and applying force to break through at some point and thus weaken it, some genius evolved the idea of using a gun and shooting away a portion by dint of repeated blows from heavy projectiles.

So they tried the gun method, the program ranging from shotguns with solid balls, to machine guns. The method was found to have some promise, but the guns would not stand up to the work.

Much publicity was released by one arms company alleging that its make of repeating shotgun was used for this purpose but the process was much more successful on a typewriter than on a clinker ring. Another company made up hollow, brass bombs filled with black powder, the bombs exploding the instant they came in contact with the incandescent ring. The scheme was not a success.

The single balls fired from the twelve-gauge repeating shotgun lacked the requisite wallop to smash away the portion of the ring at which the missiles were fired, while the gun would not last more than a thousand shots under the pleasant conditions prevailing at the kiln mouth—intense heat, grit and continuous firing.

The next step was to try an eight-gauge double gun, loaded with a three-ounce cylindrical slug of lead. This is roughly three times the weight of the ordinary round ball used in the twelve-gauge gun.

THE CEMENT KILN GUN IN OPERATION

The gun is mounted on a pivoted bracket at the end of the kiln, and is operated through a peephole

This proved to be much more successful. The projectile had the requisite punch. The only thing lacking was a simple, strong, fool-proof gun that could easily be mounted for the purpose, would inflict no recoil on the operator and would stand the strenuous conditions of the cement business. The operator of the experimental eight-bore double gun which was tried in one of the eastern plants, fired more than 200 shots in one morning through the small peephole leading into the red-hot kiln.

Three strong osteopaths finally brought his shoulder back into approximately its normal position but the experience proved that the shoulder method was entirely out of the question.

The solution of the problem, as worked out by the company conducting the experiments, the Remington Arms Company of New York, was first, using a special cartridge not chambering in any gun other than their special cement gun, somewhat similar to the eight-bore shell, but firing a heavy cylinder of lead of about three ounces. The cylinder is cut off square to give full force of impact without penetration. Next, to fire this cartridge, this company developed a simple and strong form of bolt-action, single-shot weapon, using the simple, strong, and crude door-bolt type of breech closure.

This entails no more expertness on the part of an operator than turning up a bolt handle and pulling it back as far as it will go for the insertion of the loaded cartridge, then closing it and pulling the trigger.

The Punch of an Elephant Gun

The gun has a very short barrel, a pistol grip for the firing hand and is mounted with a heavy, spiral spring at the muzzle end to absorb the recoil. The gun is mounted on a pivoted bracket at the end of the kiln with the muzzle opposite a small peephole cut in the kiln wall, permitting the operator to watch the placement of his shots on the selected portion of the clinker ring.

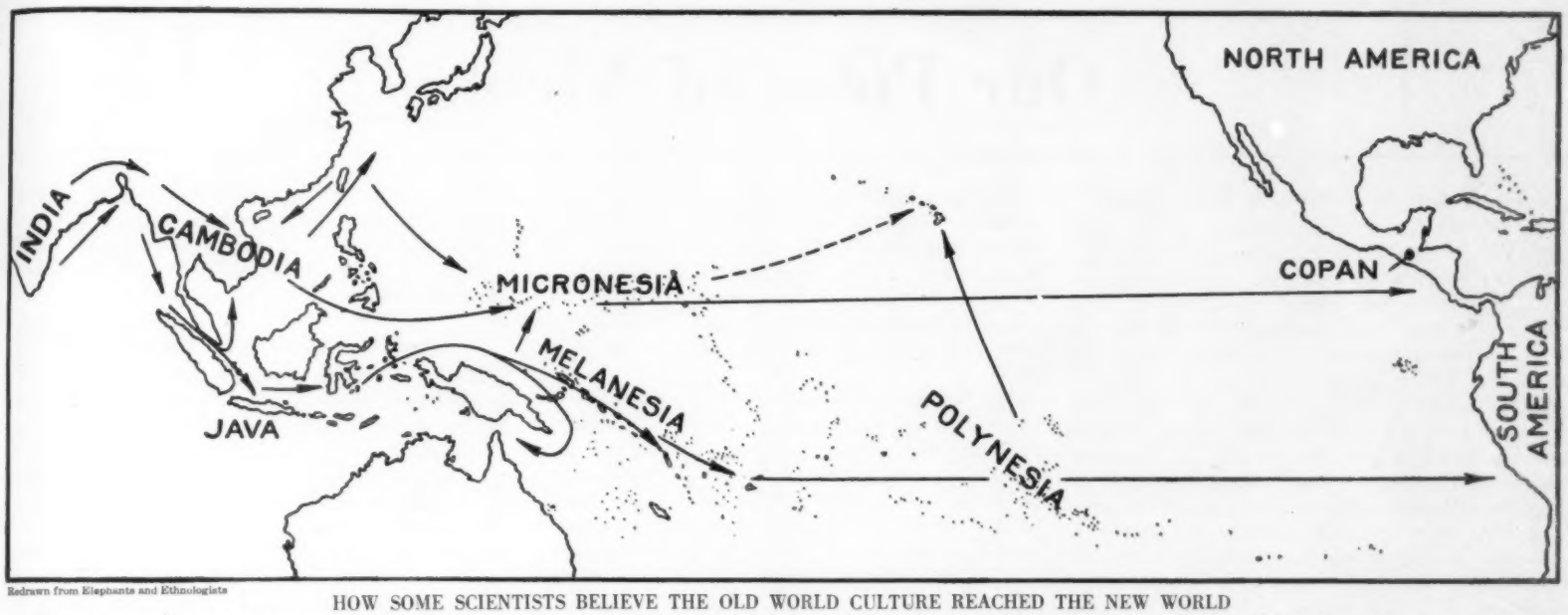
The cartridge is powerful enough to deliver a punch akin to that of an elephant gun, or tank gun. The three-ounce slug, if given a velocity of 800 feet per second, would develop an energy of better than 1,800 foot pounds and little of this would be used up in mere penetration because of the pleasing square face and huge cross section of the slug, which is eight-tenths of an inch in diameter.

The method of using the gun in breaking down the rings is to concentrate the fire on one portion of the ring, placing the bullets close together and in a row, and breaking out a keyway through the ring.

The Dewey Company, before quoted, reports that it finds it necessary to shoot the ring out as soon as it forms, an average of twenty shots being used in the process. The kilns are "down" for this purpose twice a day of twenty-four hours.

As the range is short and the mark large, no expert marksmanship is required. It is reported that almost any man who is able to hit a five-foot doorway with the front end of a wheelbarrow, can be used for this ring shooting.

At the present writing it is reported that six of these guns are in use by six different plants and that they are giving satisfactory results.



Redrawn from Elephants and Ethnologists

HOW SOME SCIENTISTS BELIEVE THE OLD WORLD CULTURE REACHED THE NEW WORLD

According to the theory of Professor G. Elliot Smith, the remarkable culture of the Mayas and ancient Peruvians came from India and Cambodia, with Chinese influence, by two routes, the northern route being the main one. This diffusion of culture across the Pacific in large canoes began at least one thousand years before Christ and continued for centuries.

Are These Elephants?

By Albert G. Ingalls

DO THE Copan sculptures made by the ancient Maya race of Honduras, which are reproduced on this page, represent in your opinion, elephants; or would you take them to be intended for tapirs, macaws, turtles or cuttlefish?

Simple as the solution of this question appears to be—for nearly everyone to whom we have shown these figures has pronounced them elephants—two factions of scientists have been engaged for years in a bitter war over it. That war has just broken out anew. Professor G. Elliot Smith, the brilliant and dynamic leader of the so-called "historical" faction which believes that the sculptures are intended for elephants, has written a book in support of his view *(Elephants and Ethnologists.* E. P. Dutton & Co., New York).

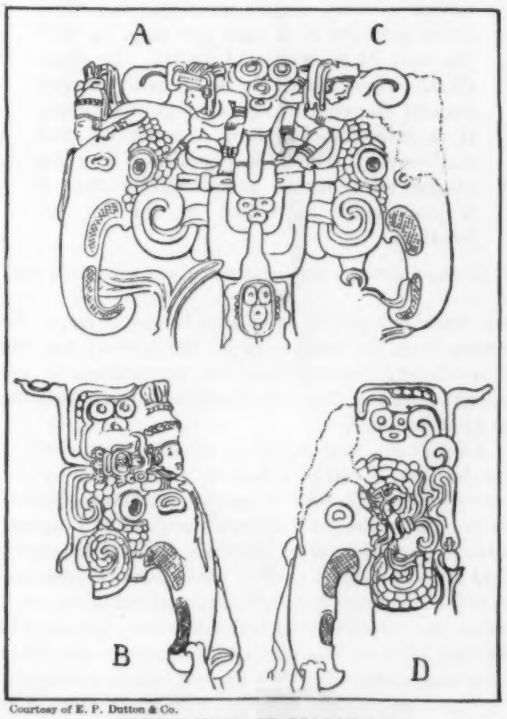
Science would not give much thought to the mere interpretation of these four Mayan sculptures were it not for the fact that a decidedly important problem of human history depends on this interpretation. If these figures depict elephants, it practically proves that the remarkable civilization of the Mayas did not originate in the New World without outside assistance, for scientists believe that there were no elephants in America at the time of the Mayas. It would point strongly, therefore, to the theory that other races of people gradually extended their adventures and explorations across the broad Pacific and finally landed, by accident, by design, or by a combination of these two causes, on the western coast of America where they took root, thus transplanting the Old World culture to the New World. This is the view of Professor Smith.

What we now call "civilization" can be traced back to historical beginnings in the countries surrounding or close to the Mediterranean Sea.

Professor Smith's idea takes the origin of all these cultures, Mediterranean, Chinese and American alike, back to a much earlier time in pre-history, when they probably arose on a fundamental basis of a sort of pre-civilization which spread over most of the world.

This supposed more ancient world-spreading culture, Professor Smith has named the "heliolithic" culture, a name derived from the words for "sun" and "stone," and so named from the customs of worshipping the sun and of setting up great monuments of single stones, like those of Stonehenge, in England. Survivals of this culture include, among other things, the custom of worshipping the sun, already mentioned; the use of the mysterious swastika symbol, signifying good luck; the "couvade"—the very curious custom of putting the father to bed when a child is born; the single-stone monuments and the building of pyramids; the custom of circumcision; the piercing of the ears; tattooing; the binding of the heads of infants, so that the skull is deformed; exogamy; human sacrifice; and the invention of agriculture by irrigation.

These things are partly commonplace and of such a nature that it is not unreasonable to think that isolated peoples might have hit on them independently in the course of centuries. No one of them, taken alone, would be convincing proof of common origin. But taken as a whole, it is difficult to avoid the belief that these customs do indicate a common source.



Courtesy of E. P. Dutton & Co.

ELEPHANTS? OR MACAWS?

Macaws, say the opponents of Professor Smith, who retorts that to prove it they single out profile D, the most seriously damaged of the four (A, C is the reverse side of B, D)

We may easily trace these elements of the heliolithic culture both east and west from Egypt or Southern Asia. To the west, they lead us across northern Africa, through Spain and France to western Ireland. To the east they appear to have spread to Mesopotamia, India, and the peninsula of Siam. Beyond this point the culture seems to have taken two eastward paths. The southernmost led through Melanesia, Polynesia and finally reached the west coast of South America where it took root in Peru. The northern branch seems to have reached Central America by way of Micronesia, or the islands of the Pacific, east of the Philippines. How? In large canoes. To quote Professor Smith: "The ancient mariners who made their way into Polynesia discovered and settled in almost every islet on that vast expanse of ocean. Is it at all likely that seamen who wandered as far as Easter Island, Hawaii, and New Zealand, refrained from going further east? Is it not certain that for every boat which chanced to reach Easter Island—a microscopic speck in far eastern Polynesia—there must have been hundreds, if not thousands, that missed it and passed on to the American coast?"

This is where the Mayan sculptures fit into the argument. In India and Cambodia the elephant had religious significance—in fact, it still has. No elephants, mammoths or mastodons lived in Mayan days in America. Is it not natural that the sculptor of the Copan monuments, descended from some earlier sea wanderer and never having seen an elephant himself, but having with him some crude, handed-down representation of the elephant, should have mistaken its eye for the nostril and its ear for the eye?

Among those anthropologists who decline to follow Professor Smith there is little tendency to deny that the same cultural elements are common to both the Old World and the New World. What they refuse to do is to conclude that this is more than a coincidence.

Our Point of View

A Call for the Automatic Train Stop

THE recent fatal accident on the main lines of the Pennsylvania Railroad between Philadelphia and New York, when an express train, running in a thick fog, crashed into the rear of another express train, causing the death of ten people and the injury of thirty or forty others, inevitably suggests the thought that had the automatic train-stop been installed on that section of the line, the collision would not have occurred. The Interstate Commerce Commission had ordered forty of the principal railroads of the country to install the automatic stop where the traffic is heavy and peculiarly exposed to the risk of collision; and in justice to the Pennsylvania Railroad Company, it should be remembered that, in common with other railroads, they have been engaged, since the date of that order, in testing out various systems of automatic train control with a view to finding one that will be thoroughly reliable and above all, weather-proof. To make a complete installation of automatic control over the thousands of miles covered by the Commission's order will involve an immense expenditure of funds; and the railroads should be allowed a reasonable time to make their preliminary examination very thorough, so that they may feel certain that the type adopted will give satisfactory service.

Apparently, the collision was due to a failure of the human element. The engineer of the second train, in spite of the fact that he had a record of twenty-five years of service without an accident, ran by the distant or caution signal, which he claims was hidden in the fog, and apparently saw the red light only when he was close upon it. The train ahead had stopped at this red light and started again when it showed clear, and was running at a speed of about ten miles an hour, when the train behind, at a speed of from fifty to sixty miles an hour, crashed into the rear steel sleeper. The impact was such that this car was telescoped into the one ahead.

The annual number of collisions on our railroads is diminishing steadily; but as long as their prevention depends upon the fallible human element, they are liable to occur. Only when automatic train control is installed will absolute safety be assured. This, as we have said, will be a costly work; and the demand for it comes, unfortunately, at a time when the railroads are struggling by rigid economies to produce that minimum dividend of six percent, which is essential if they are to secure the necessary capital for upkeep and betterments.

Mitchell *versus* Discipline

DUE to the widespread misunderstanding, we think it should be made clear that Colonel Mitchell is being tried, not for his views on aviation, but for his breach of military regulations and the means and manner of his expressing these views. It is a violation of military regulations for an officer to air his opinions on military matters by conducting propaganda through the press; and it is doubly a breach of military regulations for an officer, in a public statement, to abuse his superiors, using the word "treasonable" in describing their conduct of military affairs. If the conduct of military affairs was so bad that Colonel Mitchell felt he was called upon to make an exposé, there was only one way for him to do this—and that was to resign his commission and carry out his attack in a civilian capacity, which he would be perfectly at liberty to do.

Why is a breach of military discipline so grave an offence? For the very good reason that discipline of the strictest kind is the fundamental quality which distinguishes an army from a mob. It is discipline above all that makes an army; and it is of the very essence of discipline that each man shall subordinate himself absolutely to those who by rank are above him.

The moment a member of an army, whether he be private, lieutenant, major, colonel, or of whatever rank, begins to act on his own initiative, and proclaim his own individual views on organization, tactics or strategy, except it be in a communication to his immediate superior, that man becomes a monkey-wrench thrown into the elaborate machinery of the army. He may be perfectly well-intentioned and have at heart, or think that he has at heart, the interests of the army and of the nation; but the moment he goes outside of the regulations, he becomes a peril to that very discipline upon which the army is founded.

These facts were never so clearly recognized as by the great Washington himself (than whom no one was more sympathetic with the American soldiers of his day) when the shameful neglect of Congress caused his troops to go shirtless and without shoes, and indeed, without food in their hours of dire extremity. Nevertheless, at the conclusion of the war, when the soldiers were called together, presumably by one of their number, to take matters into their own hands and with their swords to force Congress to fulfill its pledges and forthwith grant them their full arrears of pay, Washington, with the true instincts of the soldier, addressed one of his most memorable utterances to the army and pointed out to them, even while he admitted the justice of their complaints, that, if they moved as they intended, they would be guilty of a gross act of insubordination and would rend asunder that discipline which alone distinguishes an army from a mob.

Water for Next to Nothing

It is not stretching a point too far to say that, next to the air we breathe, a supply of pure drinking water is the greatest necessity of our daily life. Elsewhere in this issue will be found an article on the greatest municipal supply of modern times, as provided by the imposing series of dams, tunnels and aqueducts which conveys pure mountain water over a maximum distance of 120 miles for the supply of the largest city of America. Since sending this story to press, there have come to our knowledge some facts as to the amazing economy with which this great work has been put through and is now being carried on. Every day of the year, there is supplied on an average, to every citizen of New York, 130 gallons of water; and the astonishing fact is that this generous supply costs the individual citizen, on an average, less than three-quarters of a cent per day, or half the cost of a decent cigarette. In these days, when there is so much protest against the cost of our city governments, it is refreshing to find a work of civil engineering which is providing a great public necessity so economically that it is practically as cheap as the air we breathe.

Shall We Abolish the Submarine?

IF the present world-wide agitation against the submarine should lead to an international agreement for its abolition, the embargo will have been due to the ruthless attack which was made by Germany on merchant shipping during the World War. Due to this, the very word "submarine" has taken on very sinister meaning, at least in the minds of the general public and, indeed, to no small extent among naval and military men. The dislike of the submarine has been intensified by the many and gruesome fatalities which have happened during the past few years to this type of vessel, culminating in the loss of *M-1*, with sixty-eight men, in the English Channel. A few weeks before that, the world was shocked by the loss of our own *S-51*, with practically its entire crew; and Italy has been depressed by a similar submarine accident. Among naval men, there is a division of opinion; but it is not to be forgotten that the Washington Conference, had it not been for the French attitude, would have committed itself to a total repudiation. If the submarine could be restricted everywhere and for all time to naval warfare, its extreme unpopularity would be modified; although it must be admitted that even in this field, its effect is more moral than practical; for it is a threat and a deadly one. After all is said and done, perhaps the public prejudice, which it seems impossible to remove, is similar to that against poison gas, and is based on the ground that it uses what the man on the street or in the field of sport would call "sneak" tactics. Human nature is so constituted that anything which carries this quality is the subject of well-deserved detestation.

Helium as a Life Saver

A CORRESPONDENT, referring to our recent articles on the loss of the *Shenandoah*, complains that we did not draw attention to the fact that the use of helium in the gas bags probably prevented the wiping out of the entire crew of the ill-fated ship. The omission was intentional and was due to the fact that in our own mind, at least, and we think in the mind of the public generally, the fact that the ship was filled with helium was so well known as to need no reiteration. Unquestionably, had *Shenandoah* been filled with hydrogen, the sparks which must have been generated by the severing of electric cables and the tearing asunder of so many metallic members, when the ship was broken into three sections, would have produced an explosion and a conflagration which would have been fatal to every member of the crew. It is true, also, on the other hand, that the superior lifting power of hydrogen and the fact that the substitution of hydrogen for helium would practically double the cruising radius of a ship, are causing airship constructors to search diligently for a substitute for the present type of motors and design a heavy-oil engine which will be free from the risks that are inseparable from the type which is at present in use. Nothing will conduce so greatly to the success of commercial aviation as the production of such an engine with the resulting substitution of hydrogen for helium, except in naval dirigibles.

Especially photographed for the Scientific American by Brown Brothers

Dr. Gilbert's envelopes being opened in the presence of newspaper representatives and members of the editorial staff of the Scientific American

Spirit Mediums Fail in Test

DR. J. ALLEN GILBERT, Ph.D., of Portland, Oregon, has been conducting a simple but effective test with the cooperation of the Scientific American. It has been a test not of the truth or falsity of spirit messages, but of the truth or falsity of communications received through spirit mediums.

More than 300 mediums have sent messages. Of that number 284 revealed what they believed to be a secret countersign agreed upon by Dr. Gilbert and Mrs. Gilbert before her death. Every one of the entire 284 was wide of the mark.

Mrs. Gilbert (Florence A. Z. Gilbert) died December 17, 1917. For months it had been evident that her death was impending. She and her husband were both deeply interested in psychology and they included among their friends a number of persons who were interested in the phenomena of so-called spiritualism. Neither of them had ever had any experience that convinced them of the possibility of communication with the dead. However, they made a compact that Mrs. Gilbert would make every possible effort after her death to communicate with Dr. Gilbert through a medium. To eliminate the possibility of fraud, they agreed upon a certain countersign which must accompany any message purporting to come from her to serve as a guarantee of its authenticity. This countersign was placed in a triply sealed envelope.

After Mrs. Gilbert's death repeated messages, reputedly coming from her, were given to Dr. Gilbert. None of them bore the countersign.

To stimulate further attempts by mediums Dr. Gilbert made a statement on May 30, 1922, through the Portland *Oregonian*, offering a reward of $500 to anyone who would obtain the countersign by communication with Mrs. Gilbert.

The result of that offer was the receipt of 139 definite countersigns, all ostensibly from Mrs. Gilbert. Desiring that a wider effort be made, Dr. Gilbert sought the cooperation of the Scientific American and extended his offer to November 1. Details were published in our August issue.

From all parts of the world messages from spiritualistic mediums were received. They came from Japan, Poland, Germany, France, Australia, some of them in foreign languages which neither the doctor nor his wife had ever spoken. There were many letters giving communications without any definite attempt being made to give the necessary countersign. A few of the mediums explained that Mrs. Gilbert was unwilling to give the countersign because she knew it would cost her husband $500.

The True Countersign Revealed

The 284 actual attempts at the countersign covered a wide range from a simple design, such as a cross, to lengthy quotations. Among them were such offerings as "True love lives beyond the grave," a square and a compass, "Jim, I am here, old boy," "Frank, I am happy," "X," "Au revoir, auf wiedersehen," a shamrock with engravings, "I have a crystal vase with white and pink roses, Dear John," "Fiddlesticks," the Twenty-third Psalm, "Hello, Old Boy." "All is well, all is well with my soul," "Amigo," "James, James, James, I am so far away, Death is so wonderful," "I am with you," a peacock feather, "Morphine, A. Z. G. F.," "Separated," favorite photo in a box, "Dear Heart," "Am Happy," "Ave Maria," "Let me sleep," "Never be afraid of the darkness."

The first message received was the first two sentences of the marriage ceremony. The last one, by a curious coincidence, was "Amen." Several addressed Dr. Gilbert as John, Jack, James or Jim, although his first name is Joshua.

All of the countersigns submitted by the mediums were assembled in the library of the Scientific American on November 12, and the triply sealed envelope brought from the vault where it had been resting since the offer appeared in this magazine. Before breaking open this envelope, however, another was read first at the request of Dr. Gilbert. It contained a letter from Dr. Gilbert to the editor of the Scientific American. It said in part:

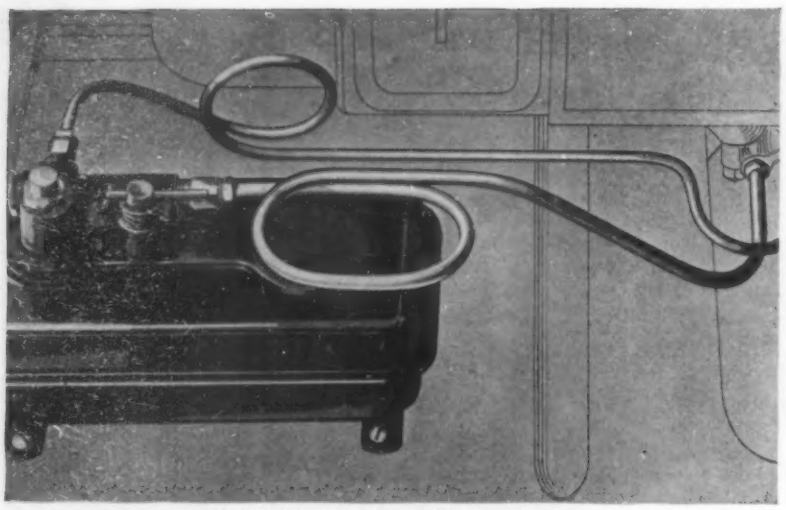
"The true countersign to be opened by you contains three events with dates for the same. In revealing the countersign it might be just as well to state the events without the dates and, if any fraudulent medium claims to have got the countersign without my taking recognition of the same in my report, his fraud would be automatically revealed by the absence of dates and his inability to give the dates, which he would have no means of knowing without a well-nigh impossible investigation."

The second envelope was then opened and found to contain on Dr. Gilbert's office stationery, dated January 1, 1918, this message:

"Before Mrs. J. Allen Gilbert's death, which occurred on December 17, 1917, she and I agreed upon a certain password to serve as identification of her if she were able to come back to me by any method whatever. The password agreed upon was to be the mention of our three birthdays, viz.: Mrs. Gilbert's, Dorothea's (our daughter) and mine. (The three dates are here named.) Request has been made of Dr. James H. Hyslop, 519 West 149th Street, New York City, New York, that he should attempt to get in communication with Mrs. Gilbert through Mrs. Chenoweth, if possible. Nightgown sent to him as an aid in that attempt. Signed J. Allen Gilbert." Dr. Hyslop was a distinguished psychic investigator, whose death occurred some time after the password was sealed.

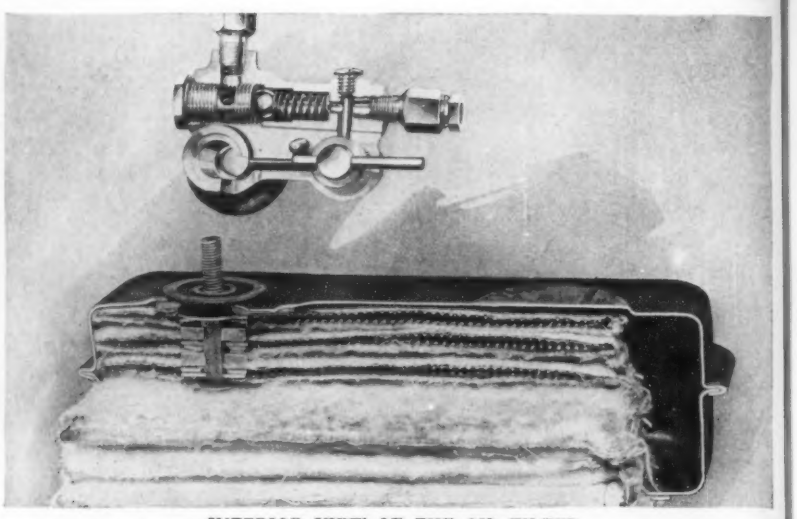
After being read, this note was again placed in a sealed envelope and returned to the vault. None of the mediums had stated what it was. If any hereafter should allege communication with Mrs. Gilbert, there still remain the three dates to serve as a password.

Thus is completed a test of spiritualism pure and simple. The part played by the Scientific American has been as an aid to Dr. Gilbert in his effort to receive a message from his deceased wife, if such messages are possible. Whether it proves or disproves anything we leave for the reader to judge. It should not be confused, however, with the larger field of psychic research, nor with the investigation of so-called supernormal phenomena this publication has been interested in for the two past years.



EXTERIOR VIEW OF THE OIL FILTER

It consists of layers of fine wire screen and felt filtering material. A valve permits of the oil circulating without passing through the filtering material if the latter becomes clogged



INTERIOR VIEW OF THE OIL FILTER

This view shows the wire screen and filtering material. The by-pass, by means of which the filter is cut out of the line of circulation, in case of stoppage, is also shown

Comfort from Your Motor

By H. W. Slauson, M.E.

I MEAN exactly what I say by that title; not comfort alone from low-pressure balloon tires, long, flexible springs, quick-acting snubbers and shock absorbers, or rich and luxurious upholstery and seat cushions, *but real comfort from within the motor itself*. That is the one big, outstanding development of 1926 motorcar design, and constitutes one of the most important chapters of the romance of the automobile industry.

Up to a few years ago, the gasoline power plant that drives our automobiles could hardly be looked upon as a source of comfort. It developed the power of some ten to fifty horses, and as such was expected to produce as much noise and exhibit as much temperament as at least a team of high-spirited horses. Then came improvements in design which reduced the factor of temperament almost to the vanishing point and made the modern internal-combustion motor one of the most reliable power sources yet developed. Supplementing these mechanical improvements, which produced greater reliability, was a marked reduction in the amount of noise generated by the motor—for, with the exception of the exhaust, noise means friction and wear, and where these are reduced, an approach to silence follows.

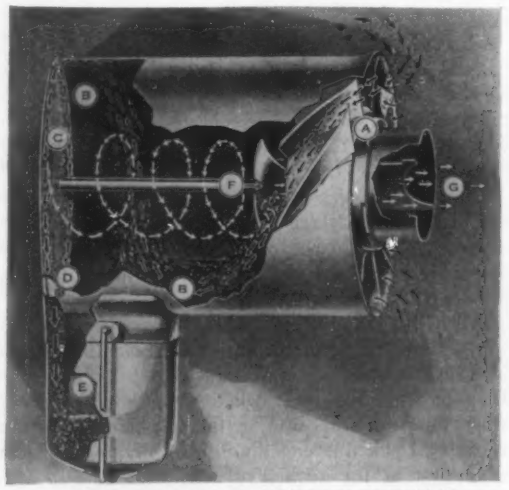
Vibration Due to Lack of Balance

But even this approach to silence did not last long, for vibration and wear will soon throw a motor out of "tune" and not only does vibration produce wear and make a motor noisy, but the sensation which it conveys to the occupants of the car is not pleasant.

Vibration is due to a lack of balance or stability when an impulse is applied to any material. Vibrations may vary in time or period from the slow, steady beat of a long pendulum, to the infinitely rapid shiverings of the high-pitched tuning fork. Now the moving parts of a gasoline engine are naturally unbalanced, for the crank, connecting rods, and pistons constitute unequal weights throughout various portions of the revolution of the crankshaft and flywheel. Fortunately, this apparent unequal distribution of weight may be overcome in some types of engines by so arranging the cranks that when one mass of cylinders and connecting rods is moving upward, an equal mass will be traveling downward.

In the case of those crankshafts which cannot be thus balanced, however, resort may be made to the use of additional counterweights or balances, which will exactly offset the amount of the weight on the other side of the crankshaft. Machines have been developed which will balance these crankshaft assemblies almost to the weight of a postage stamp, and the flywheel, crankshaft, connecting rods and pistons of an engine so balanced, may be run by an external source of power, at almost any speed within reason, with no ensuing destructive vibration.

But note that I said that such an assembly may be run by *external* power. As soon as we introduce the tremendous impulses of the explosions, or rapid combustion rather, on which we are dependent for the generation of power within our gasoline engines, we face an entirely different set of conditions. Consider that one piston of a four, six, or eight-cylinder crankshaft assembly is suddenly struck a tremendous blow of five or six hundred pounds. There is a natural lag, or inertia, in the rest of the crankshaft and its assembly, which prevents it from responding instantly to this tremendous explosive force, and there is therefore a twist, or winding, of one part ahead of the action of the remainder of the crankshaft assembly. If we balance a board across a saw-horse, and suddenly push down on one end, the other end will rebound upward it is true, but not until a very considerable distortion has taken place in the plank; and when this other end does spring upward, it goes farther than the original end, because of the energy stored by the springiness of the board.



A CENTRIFUGAL TYPE OF AIR CLEANER

The dust-filled air enters through the outer ring. The vanes and baffle plates impart a swirling motion to the air. The direction of the clean air is reversed and it enters the carburetor from the opening indicated by the white arrows

Therefore, we cannot consider even a heavy, steel crankshaft to be solid and inflexible when dealing with the causes of vibration. There is an infinitesimally small twist or whip to any crankshaft when subjected to these tremendous impulses generated by the explosions in the cylinders. At most speeds this vibration may not be apparent, or it may be neutralized by other conditions. At other speeds, however, possibly within a limit of but two or three miles per hour, the vibration may become so apparent as to transmit a violent shaking to loose fenders, lamp brackets, hood catches, and the like until the entire car seems to be suffering with St. Vitus's dance. The speed at which this violent vibration occurs is known as the critical speed, and the motor is said to possess a "period" of vibration.

Increase in Number of Bearings

Obviously, one of the most logical ways to overcome this is to furnish the crankshaft with as much rigidity and stiffness as possible, in order to prevent distortion. This can be accomplished by making the crankshaft large and heavy, and by supporting it by means of large main bearings at frequent intervals throughout its length. This furnishes a resistance and stiffness to the whipping and distorting effect of the impulses in much the same manner as a light, flexible plank will be made to give less when we walk upon it if it is placed over beams which are set close together. Thus, the crankshaft of the new cars are not only larger than might be found previously, but are plentifully supplied with bearings, and in many instances we find five-bearing four-cylinder motors, seven-bearing six-cylinder engines, and the crankshaft of eight-in-line power plants supplied with nine main bearings.

Fortunately for designers and motorists, vibration can be neutralized or absorbed. A swing, or other pendulum-like object, furnishes an excellent illustration of slow vibration. A small child can swing a heavy person high, if he gives a slight push at exactly the proper time. On the other hand, if he

pushes at the wrong time, he can easily stop the swinging eventually, by neutralizing it.

Vibration is thus the compounding of a series of impulses, timed in exact accordance with the period of the vibrating beat.

Motorcar engineers have analyzed the cause of crankshaft vibration, and have installed neutralizing devices which, with the changes in design already outlined, have served practically to eliminate this heretofore annoying adjunct of motoring. One type of device is built within the crankshaft itself, and consists of a pivoted bar placed along one of the crank arms. Each end of this short bar is kept from direct contact with the crankshaft arm by means of a flat steel spring. This pivoted bar, of course, revolves as a part of the crankshaft and through its ability to change its position slightly, when the rapidly-turning crankshaft is twisted out of position by the impulses of the explosions, serves to neutralize or absorb the vibrations that would otherwise be set up.

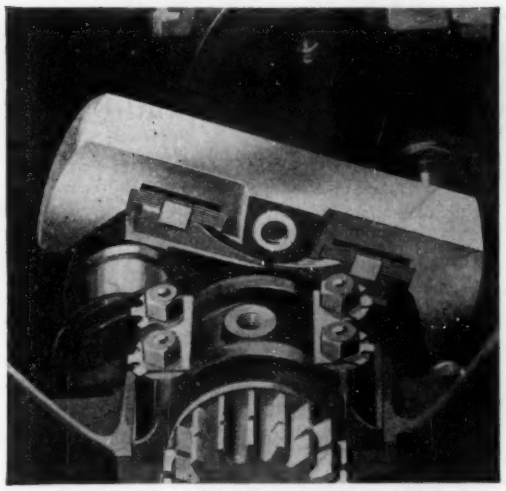
One of the most effective means of absorbing vibration consists of "dampers" in the form of friction disks, or revolving weights which serve wonderfully well to smooth out the inherently rough portions of the period.

As drops of water will wear away the hardest stone, so will constant vibration set up a rapid deterioration in the mechanical parts of the car.

The Importance of Oil Filters

But vibration is not the only cause of wear in an automobile. Wear is caused by friction, and friction occurs whenever fabric or metallic parts move in direct contact with each other. It is the purpose of lubrication to interpose a film of oil between all moving surfaces, and thus to reduce friction to a minimum. Properly designed lubricating systems perform this function wonderfully well, provided the oil can be kept clean and of the proper consistency or body. The oil is the very life blood of the motor, for it circulates to every vital part. Therefore, if this life-preserving fluid carries disease germs in the form of dirt, grit, or other foreign substance, the very purpose of the lubricating system will be defeated. Consequently, it may well be stated that the second most important development of automobile motor comfort consists of the attachment on many of the new cars of devices for reclaiming or rectifying the crankcase oil and for preventing the entrance into the engine, through the carburetor, of dirt and dust.

Oil purifiers are more necessary now on automobiles than was the case ten years ago when the gasoline then used for fuel was easily vaporized, and excessively rich mixtures were not needed for starting a cold engine. Today's fuel vaporizes at a much higher temperature, and this means that the rich mixtures required for starting are easily condensed into a liquid which runs down the walls of the cylinders, and into the crankcase oil. This liquid fuel, therefore, not only dilutes the lubricant in the crankcase, but during its passage down the cylinder walls, it washes with it the dirt and dust which may have been sucked in through the carburetor. Particles of carbon which will be loosened from the piston and cylinder head, may also be washed down into the reservoir containing the lubricant. This foreign matter, when circulated with the diluted oil, forms an excellent cutting compound similar to a valve-grinding material, with the result that the bearings and other moving parts of the engine, instead of being thoroughly lubricated, are ground away by the very means intended to prevent wear.



NEW TYPE OF CRANKSHAFT BALANCER

A flat spring keeps each end of a pivoted bar away from the arm of the crankshaft until a vibrating force occurs in the latter. Then one spring or the other is depressed and a counter force is generated which absorbs this vibration

In order to reclaim the oil thoroughly, therefore, the oil purifiers now found on many of the new cars serve two purposes. The first is to filter the foreign matter from the oil by forcing it through various thicknesses of filtering material and fine mesh screen. The second is to subject this oil to sufficient heat from the exhaust of the motor to drive off the condensed gasoline and return it, in the form of fuel, to the intake manifold of the engine. The lubricant is thus restored to its former efficient state, and when so treated, does not require replacement or renewal more than once every thousand to three thousand miles, depending upon the efficacy of this treatment. The oil purifiers are generally in the form of a small circular or square tank, piped to the intake manifold and crankcase of the engine. The purifier is not always placed directly in the oil-circulating system of the engine, for its capacity might not meet the total, full-power requirements of the engine. The entire amount of oil in the crankcase, however, is passed through it at frequent intervals, the necessary force sometimes being obtained from suction which is secured from the intake manifold near the carburetor.

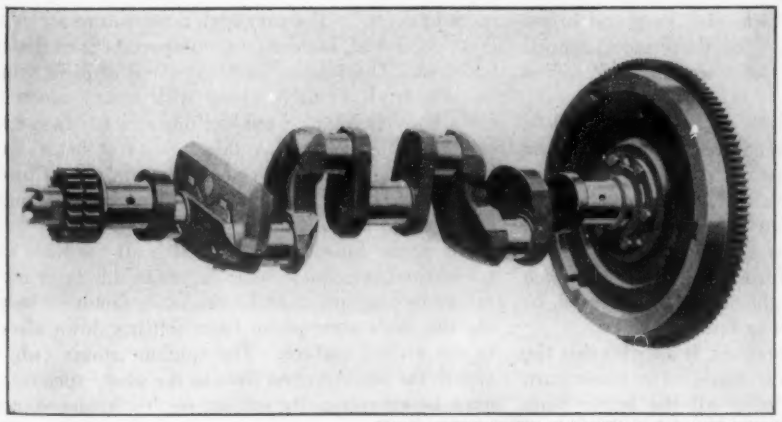
But of equal importance with reclaiming the oil is the prevention of the entrance of the dust and other abrasive foreign matter, which is a part of each breath of air taken by the motor.

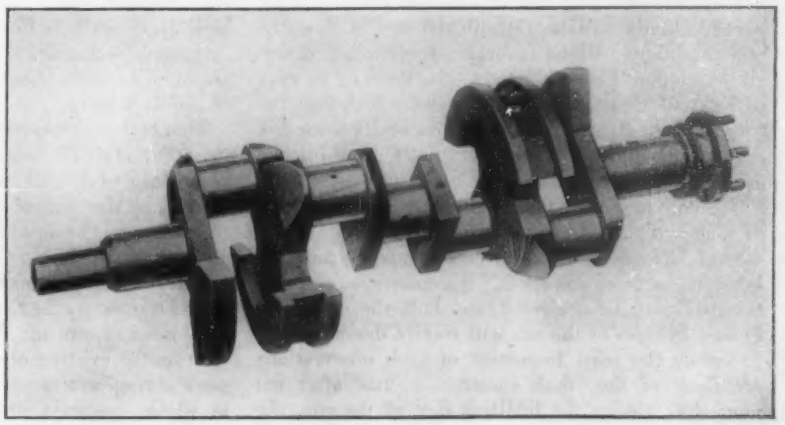
It might seem to be an easy matter to cover the air intake opening of the carburetor with a series of screens and filters which would catch all of the foreign matter contained in the air passing through. We cannot afford to starve the engine, however, by placing too much resistance in the path of the air which it demands. The air is not forced into the engine under pressure, but is sucked in by its own suction pump efforts, and if the cylinders have not been filled by the time that the piston reaches its downward stroke and the intake valve has been closed, the engine will not have received its full charge of explosive mixture, and we cannot expect full power and efficient results. Therefore a large filtering area with many passages must be provided or the dirt must be thrown out because of the difference in weight between it and the air which is carrying this foreign matter.

Vibration and Friction Greatly Reduced

This second system is known as the centrifugal type. By means of baffle plates, vanes, and in some instances, small rotating fans, the incoming air is given a rapid whirling motion, similar to that imparted to the milk in a cream separator. Through one of the primary laws of physics, the heavier dust and dirt is thrown outward, and is caught in a trap, or expelled directly into the outside air. The incoming air, thus freed of the heavier particles of foreign matter, passes into the cylinders of the engine in a comparatively harmless form. Another ingenious system of air purifier employs a connection with the exhaust pipe of the engine to create an injector effect to blow the trapped particles of foreign matter from the air cleaner directly into the outside air.

No matter how easy its riding, the car in which oil must be changed every four or five hundred miles, carbon removed every two or three thousand, bearings tightened or replaced every ten thousand, and a general overhaul given every twenty thousand or so miles of travel, cannot be a real comfort and pleasure to its owner. Therefore, the marked reduction of engine vibration and the very thorough protection of all moving parts against friction, created by inadequate lubricating materials and the entrance of foreign matter directly into the very vitals of the engine, may well be looked upon by owners, as well as by engineers, as two of the most important advances in the past fifteen years of motorcar development.





FINE COUNTERBALANCING IS ACCOMPLISHED BY TWO MODERN CRANKSHAFTS

A six-cylinder crankshaft, with a new type of balancer attached at the left-hand crank throw

In this, a special machine drills holes in the counterweights till balance is attained

American Eclipse Expeditions to the Far East

The Total Eclipse of January Fourteenth Should Teach Us Much About the Sun

By Henry Norris Russell, Ph.D.
Professor of Astronomy, Princeton University
Research Associate of the Mt. Wilson Observatory, California

THE chief astronomical event of the present month is undoubtedly the total eclipse of the sun, which happens on the 14th. Although similar to the eclipse of the year before in the essential feature that the moon's shadow reaches the earth, and plunges the regions which it traverses into darkness, it is curiously unlike it in detail. Last year's eclipse was visible only in the western hemisphere; this year's will be visible in the eastern. The former was observed in the bitterest cold of winter; the latter will be seen in the endless summer of the tropics. The earlier eclipse passed over densely peopled regions, and it was seen by millions of well-informed people; the forthcoming one can be seen only in thinly settled and primitive lands where few of the inhabitants will understand its full meaning.

The moon's umbra first reaches the earth as the sun is rising in Central Africa. Sweeping across north of Lake Victoria, it passes out to sea, just south of the equator, and for four thousand miles traverses the Indian Ocean. Coming to land again in Sumatra, it crosses the southern part of this island, traverses the whole width of Borneo, reaches the island of Mindanao in the Philippines, and then loses itself in the Pacific. The region within which a partial eclipse is visible extends over the eastern half of Africa, and includes Arabia, India, China and northern Australia.

American Eclipse Expeditions Will Go

The eclipse is a long one. The maximum length of totality—four minutes and ten seconds—can unfortunately be observed only in the Indian Ocean, but a duration of three minutes and twenty seconds can be secured on the west coast of Sumatra. The best observing stations are in that region. In Borneo and the Philippines, the sun is much lower in the sky and the duration shorter, and conditions on the west African coast are no better. Weather probabilities are, however, none too favorable, although these again are best in Sumatra.

Despite these uncertainties, and the great distance, several astronomical parties are on their way to observe this eclipse. Two are American—one from the United States Naval Observatory, including also Dr. Anderson from Mt. Wilson, and another from the Swarthmore and Allegheny Observatories, under Dr. Miller and Dr. Curtis. A Dutch and a German party are also en route.

The proposed program of observations is a long one. The sun will be high in the sky in Sumatra and conditions will be favorable for another observation of the "Einstein" effect—the bending of rays of light which pass close to the sun. Although the results of the Australian expeditions really settle the matter, one more good set of plates would make assurance doubly sure.

The corona will be photographed with instruments of long and short focus, showing—if the skies favor—what changes in its form accompany the increasing abundance of sun-spots. Spectroscopic observations will not be neglected, and both the outer and inner envelopes of the sun will receive due attention.

Among the most important of such observations are those of the "flash spectrum." Just after the moon has hidden the brilliant disc of the sun, the sun's atmosphere is still visible, rising several hundred miles, and appearing to the eye as a brilliant steel-white line along the dark moon's edge. Photographed through a prism—or with a concave grating—the light of this atmosphere gives a perfect line of information about the sun. One must work quickly, for in a few seconds the advancing moon covers up the sun's atmosphere altogether; but exposures by a watchful observer can be timed just right. Even better, perhaps, is an automatic device which records, on a moving plate, the whole sequence of changes in the spectrum, from the time when the bright surface of the sun is still strongly visible until the atmosphere is quite covered by the moon.

APPROACHING "SECOND CONTACT"
As the moon's shadow thins the sun's waning disc, the astronomers will stand at their stations. All is ready

The spectrum of the glowing gases of the solar atmosphere consists, as might be expected, of bright lines, matching the dark lines of the ordinary solar spectrum, but some of these lines are emitted only low down in the atmosphere, close to the photosphere, and appear on the photographs as narrow, short images, while other lines, which are emitted high up as well as low down, give long and broad "crescents"—that is, images of the crescent-shaped arc of solar atmosphere which rises beyond the edge of the dark moon.

The beautiful observations of Professor Mitchell in 1905 and 1925 show that the height to which the same lines were visible was not the same in the two cases, and further observations, perhaps at many eclipses, will be needed to confirm this variation, and study its laws. The moving-plate apparatus will furnish important information, telling us which lines brighten up first, as the sun itself observed, as well as which are the first to fade away.

From the existing observations, it appears that the sun's atmosphere is very extensive. The lower part, in whose spectrum practically all the bright lines are to be found, rises some two hundred miles above the photosphere. In the next few hundred miles most of the lines fade out, but the stronger ones, even of heavy metals like titanium and iron, rise to 800 or 1,000 miles. A few lines go much higher, up to 4,000 miles, and a very few—belonging to hydrogen, helium, and calcium, rise to 8,000 miles, all around the sun, forming the chromosphere—and above this again to great altitudes in the prominences.

These unquestioned facts raise many difficult problems. How much material is there in this great atmosphere of the sun? Why does it rise so high, in spite of the powerful force of gravity at the sun's surface, nearly twenty-eight times as great as on earth. Above all, why do heavy atoms like those of calcium rise as high as the far lighter ones of hydrogen and helium?

First, as regards the quantity of gas in the solar atmosphere, the independent work of several investigators—Milne at Cambridge, Miss Payne at Harvard, and Stewart and the writer at Princeton—show that the pressure and density must be very low.

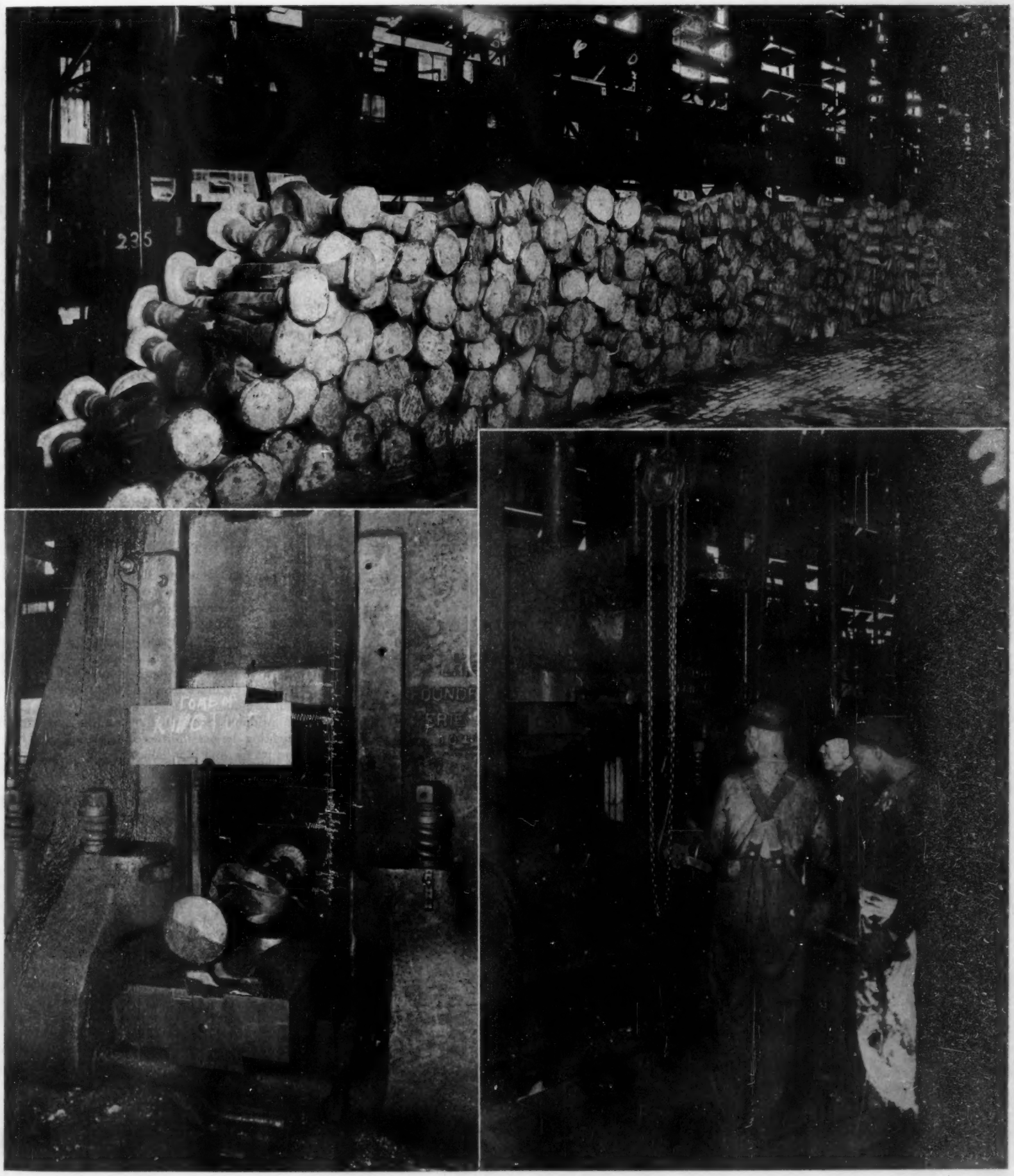
The Powerful Pressure of Light

When the gas has a hundredth of the pressure—and, at its high temperature, less than a thousandth of the density—of ordinary air it must be rendered hazy by various processes involving the inter-action of electrons, atoms and light-waves, so that on the scale of solar phenomena, it would appear opaque and be part of the brilliant photosphere. Indeed, Milne's latest calculations indicate that this would happen at a density a hundred times lower still. The transparent atmosphere above this level must be of extreme tenuity. At the maximum, there can hardly be more gas above the photosphere than would make, if compressed, a layer as dense as air and ten feet thick. At the minimum, the thickness of the corresponding layer may be only an inch.

A few feet or inches of air, then, expanded to form a layer hundreds of miles deep—this is the conception of the sun's atmosphere to which modern physics leads us.

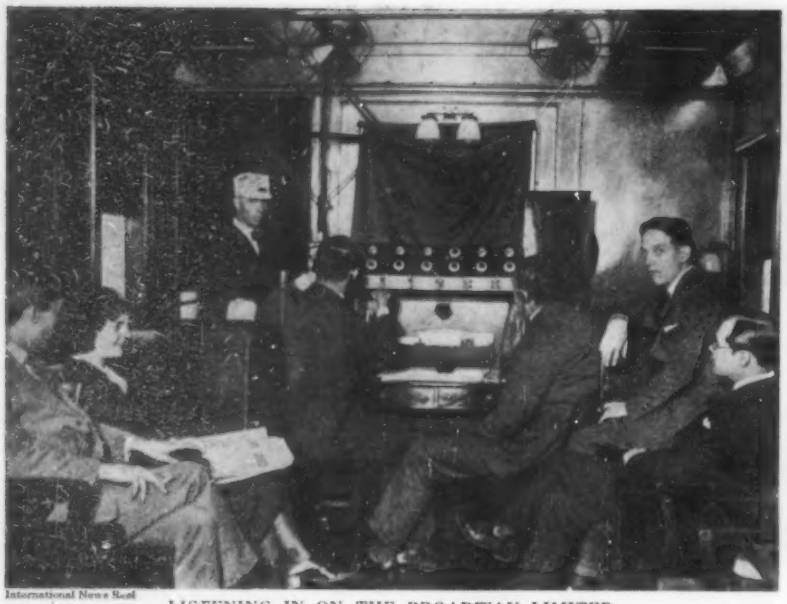
One may wonder how so thin an atmosphere can absorb the lines of the solar spectrum; but the outer vapors of an electric arc, charged (for example) with sodium, although but a fraction of an inch in thickness, can absorb the sodium lines more strongly than the sun's whole atmosphere does—as direct comparison shows. This, then, need not trouble us. But by what means is this minute amount of gas expanded into an atmosphere a thousand miles and more in depth? The very high temperature accounts for a good deal, but even more important is radiation pressure. The intense outgoing flood of light from the sun tends to drive along with it any obstacle. On a body as big as a pebble, this effect is insignificant, but on such a tiny thing as an atom, it may be great enough to balance even the sun's great force of gravity, if the atom absorbs even a small part of the sun's light.

Above the lowest layer, in which all the lines are found (and perhaps to some degree in this layer too) radiation pressure must be the main factor in keeping the sun's atmosphere from settling down closer to the visible surface. The calcium atoms (which absorb the two strongest lines in the whole spectrum) must be exceptionally subject to this influence, and hence it is not surprising that they rise as high even as hydrogen.



Steps in the Manufacture of the All-important Rear Axle

The strength of an automobile depends largely upon the strength of the rear axle. In these photographs, furnished us by the Timken Axle Company, the first step in the process of manufacture is illustrated. TOP: *Drop forgings ready for machining. Accuracy in forging saves much time and metal in the finishing process, where every motion and every minute is figured down to minimum.* LEFT: *This rear end forging is being removed from the dies which have formed it, to dimensions allowing for the right finishing cut. Machines are often named or some humorist leaves his mark thereon.* RIGHT: *Steel ingots at just the proper temperature are roughly blanked out in the drop forge. The accuracy attained in the operation of the hammer is amazing, deft stunts being sometimes performed for interested visitors. After finishing each piece, the dies are cleaned out by compressed air.*



International News Reel

LISTENING IN ON THE BROADWAY LIMITED

Picking up concerts in a railroad car is much easier than is the work of transmitting messages from moving trains

Wide World

GERMANY'S SUBURBAN TRAINS ARE RADIO EQUIPPED

Several trains leaving Berlin carry radio receiving apparatus. Headsets at the seats permit the passengers to listen in

Giving Trains a Radio Voice

Wired Wireless Is Apparently More Adapted for Service on Railroads than Is Space Radio

By Orrin E. Dunlap, Jr.

EVER since ocean voyagers have been able to communicate with their homes, travelers have wondered why the railroads have not utilized radio for the convenience of passengers and for train dispatching. The truth is that numerous experiments have been conducted by the railways, but radio engineers in signaling from moving trains have been confronted by difficulties not prevalent on board ship.

Radio service on trains has been handicapped, because the aerial must necessarily be low in order to pass tunnels and other clearances. This dwarfed antenna will intercept broadcasts, but it is not efficient as a means of radiating Hertzian waves. Aerials on top of trains are likely to be directional and the signals fade when the cars pass around curves, because the direction in which the wire points is changed. The Louisville and Nashville Railroad found that a single wire strung around the dome of the roof and clearing the dome by four inches was most efficient. The antenna was tapped and lead-ins run to the interior of the cars. Care must be taken that the dome of the car does not shield the wire, because the permissible location of the antenna in relation to the roof is confined to a small space.

Transmission Poor on Trains

The surroundings of a train differ every second. One location might be ideal for radio transmission, but a few minutes later the aerial is likely to be shielded by a mountain or by woods. An hour later it may be in the center of a city. A ship's radio installation does not have to contend with these varying conditions.

Short-wave transmitters have also been tested on moving trains, because this type of apparatus does not require a long aerial, but there is a "dead" area around the low-wave station. Although short waves travel long distances, they are not dependable for such short-distance communication as might be needed from train to train or from train to station.

The Delaware, Lackawanna and Western Railroad conducted experiments in 1914 with radio on trains running between Hoboken and Buffalo. During the past summer the Great Northern Railway made tests to determine the feasibility of dispatching trains over the Rocky Mountains by radio, chiefly for emergency use during severe winter weather, when interference is encountered in the operation of telegraph lines through the mountain region. Reports stated that the tests were not successful, because of static and other obstacles to reliable communication.

Underwood & Underwood

RADIO SUPPLEMENTS THE TRAIN WHISTLE

The engineer on the Virginian Railway pulls a cord which automatically sends a wired wireless signal back to the helping locomotive. The reply or acknowledgement comes in a similar way through the loudspeaker in the cab

The Canadian National Railways has ten broadcasting stations scattered across the Dominion and the trains are equipped with receivers to entertain passengers. Headphones hang near the seats in some of the cars, so that anyone may listen without disturbing others, as would be the case if a loudspeaker were used. Another advantage of the headset is that it excludes external noises caused by the train in motion.

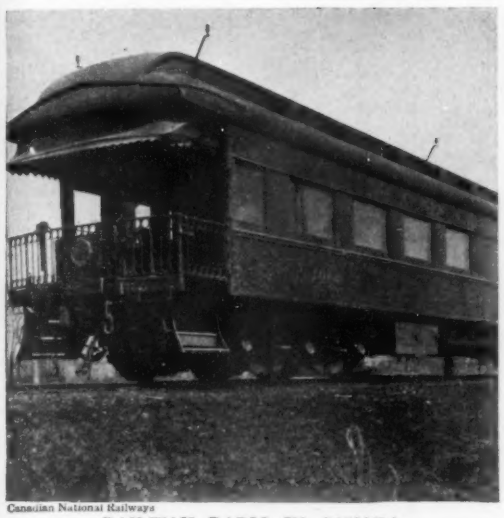
The Midland Scottish Railway, in England, is investigating the possibilities of communicating from moving trains, and it is hoped that it will be practical to send and receive messages on the Scottish Express and other crack trains of the line, and possibly effect telephone communication by relay through an ordinary telephone exchange.

No Tuning Necessary

Some engineers have turned their attention from space radio to wired wireless, or carrier-current telegraphy, as a means of signaling from trains. This method employs high-frequency current, but instead of the energy being broadcast, it is guided over existing conductors, such as trolley wires, power lines, metal pipes, the third rail, and telegraph or telephone wires.

Although wired wireless is more limited in scope than space radio, it has numerous advantages which make it particularly suited for service on trains. It requires less power, because the energy is not broadcast; there is less chance for interference from static or from radio stations; if the conductors are broken during a storm, and if the gap is not too big, performance of the wired wireless system is still possible; it does not interfere with the regular duty of wires over which the carrier current is sent. Furthermore, wired wireless is not classed as a radio installation. Therefore, a government operating license is not necessary and an operator is not required to be on watch at all hours. The carrier current transmitter is only in operation when the operator is signaling. This effects economy in tubes and power.

The basic electrical features of regular broad-



Canadian National Railways

RAILWAY RADIO IN CANADA

A library-compartment car of the transcontinental service, Canadian National Railways, equipped with radio receiving apparatus, showing the manner in which the antenna is erected. There are forty cars of this type in service

casting equipment and wired wireless apparatus are identical. Standard instruments and vacuum tubes are employed in both cases. Two different frequencies are used in wired radio to permit duplex operation, that is, the same as over the telephone.

The aerial of a wired wireless system is placed close to a high-tension or trolley wire. The high-frequency current is thus superimposed upon conductors, and receivers scattered along the route, connected with antennas in close proximity to the elevated wires, detect the messages. No tuning is done. All adjustments of the transmitter and receiver are made previous to installation.

The latest automatic system of wired wireless communication for railroads has been developed by the Westinghouse Electric and Manufacturing Company, for the Virginian Railway, for the purpose of establishing communication between the front and rear of long freight trains, some of which are a mile in length.

The route of the Virginian Railway passes over the Alleghany and Blue Ridge Mountains and a section of the course operates on a two percent grade, with many curves and tunnels. This portion of the road has recently been electrified to permit more rapid handling of trains on the heavy grades. Generally, one locomotive is used at the head of the train and a helping engine at the rear. The problem has been to secure synchronous action between the two locomotives, especially in starting and stopping. Air whistles used on electric locomotives do not carry as far as steam whistles used on steam engines, so it became necessary to devise a new signaling system for the electrified road.

Wired Wireless Solves the Problem

Tests with wired wireless showed that it would solve the problem, and permanent installations were made. The trolley wire is used as the conducting medium, making it necessary to equip only the engines and cabooses. The transmitter and receiver are mounted in steel boxes, rigidly built to withstand vibration. A motor generator driven either from a storage battery or from the source of power supplied to the electric locomotive, furnishes the high-voltage output for the plate supply to the transmitting tubes. The transmitter consists of a 50-watt master oscillator tube operating two 50-watt power amplifying tubes connected in parallel. The receivers comprise the necessary tuned circuits, a detector and two audio-frequency amplifiers.

The Virginian's equipment was designed for telephony and signaling, but it is arranged only for signaling. A small control box is attached to the ceiling of the cab and a cord which hangs out of the box is handled by the engineer in the same manner that he would handle the whistle cord. When the engineer desires to signal, he pulls the signal rope half way out of the control box. This starts the motor generator and sends high-frequency current out over the wires. He then pulls the rope all the way down and the output is modulated by a 500-cycle modulator, producing a whistle-like note in the loudspeaker at the other end of the train. The code is similar to that used for whistling on railroads. The message can be acknowledged and communication carried on in the opposite direction.

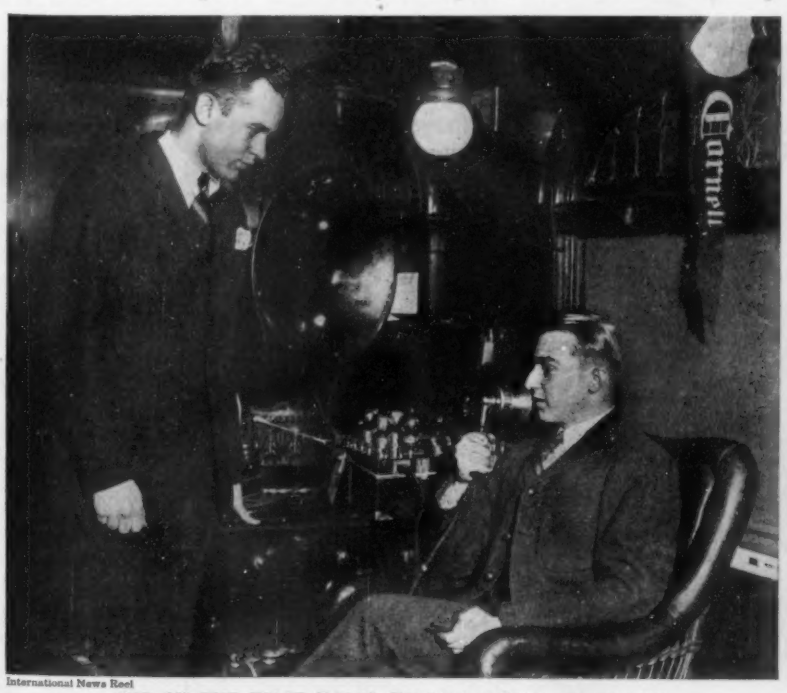
Germany is developing a system of wired wireless whereby passengers on railroads will be able to telephone to any telephone number in Germany and also be reached by telephone from any point in the country. The plan is to have a central station, whence connection will be extended to any home or office possessing a telephone. Likewise, anybody telephoning to the central station can reach the express trains and ask for any passenger, who will then be paged and taken to the train's radio station, whence he can talk with the person calling, exactly as over the ordinary telephone. Only a few minutes are required to get a connection with Berlin. The toll does not exceed that of an ordinary long distance phone call of equal length. Telegrams will also be handled by the train's radio station. Passengers can drop a coin in a slot in front of their seats, whereupon they will be provided with a headset to pick up concerts and news.

American telephone officials have expressed the opinion that the German system is not commercially practicable in the United States, because of the maintenance expense, and the public seems to find its needs met by the telegraph facilities at each station *en route*. Furthermore, they claim that the speed of American trains makes sending of messages unnecessary.

International News Reel

AERIAL WIRES ON THE D. L. & W. TRAINS

This is the method first used by railroads in erecting antennas. The necessity of keeping the wires close to the steel roof of the car, because of tunnels and other clearances, reduced efficiency and the system was not adopted



International News Reel

ONE OF THE FIRST RADIO INSTALLATIONS ON TRAINS

In 1914, the Delaware, Lackawanna & Western Railroad equipped one of their trains with this apparatus to communicate with their stations at Hoboken, Binghamton and Buffalo. Amateurs along the route often talked with the train

Wide World

RADIO CONCERTS FOR CANADIAN RAILWAY TRAVELERS

If the broadcast is of interest to all passengers in the club car, the loudspeaker is switched into the circuit. Otherwise, headsets are provided each traveler, so that the radio will not disturb those who do not care to listen in

Courtesy of the American Museum of Natural History

The extinct sabre-toothed tiger of the Pliocene Epoch. His jaw could open abnormally, exposing the scimiter-like upper canine teeth which had developed into great tusks

Men of the Early Glacial Epoch

In England, Flint Implements 500,000 Years Old Have Been Found

By J. Reid Moir

President of the Natural History Society of Ipswich, England

EVEN before the first advance of the great glaciers which during half a million years alternately crept over the northern part of the earth and melted back again, East Anglia, a part of eastern England, was peopled by primitive races of men about whom we know only what may be inferred from the crude flint implements they left, but about whose environment the fossils of plants and animals, buried in strata of this far-off period, tell us much of value. This was the Pliocene Epoch.

Then came the Pleistocene, or glacial, Epoch, with its deep cap of ice which invaded most of England. It drove man out, presumably, for we lose sight of him for perhaps 100,000 years. But when the ice had again melted back far enough to expose the soil of England during the first interglacial stage we find other evidences of early man; and in Germany, from which the England of that distant time was not then separated, we find the famous jawbone from Heidelberg, massive and thick, indicative of a powerful race. It is, then, of these two times that our present story treats.

When England Was Sub-tropical

If we could have visited East Anglia towards the close of the warm Pliocene Epoch we should in all probability have seen a country of wide plains, well watered with lakes and rivers, and supporting a large and varied series of animals. We would have witnessed the movements of great herds of the mastodon, a remote ancestral form of the modern elephant; the hipparion, a three-toed ancestor of the horse; ancient types of rhinoceros; and hyaena, the giant beaver, deer, and other creatures which have long since become extinct. These animals are such as could only live in a warm climate. So we know that Eastern England was enjoying sub-tropical conditions towards the close of Pliocene times.

But, though we would have been deeply interested in the mammalian life of the ancient East Anglian land surface, yet this interest would have been entirely eclipsed by the excitement experienced if we had come suddenly upon a party of the prehistoric people of those days.

There is no doubt that these remote ancestors of man would not have been over pleasant to look upon, as they must have exhibited many ape-like characters in their forms and features. We may imagine them as of low stature, very strong, with immensely long arms, and large hands. Their bodies were clothed in hair, and their skulls were long and low; while their jaws projected, and contained canine teeth almost as prominent as those of an ape.

It is upon such a party of early men that we have now come in our journey over Pliocene East Anglia, and we observe they are engaged in breaking up large masses of flint, and shaping them into implements of various kinds. The majority of the flints are fractured by means of smooth, heavy, well-rounded hammer-stones which are held in the hand.

Courtesy of "Natural History" and the author

CLIFF AND FORESHORE NEAR CROMER

As the present North Sea erodes this cliff away, new sources of early Stone Age implements are exposed

We notice that these ancient flint flakers are adept at removing large flakes of flint by means of very strong and skilful blows, and that these flakes are quickly and dexterously trimmed with smaller hammer-stones into implements for scraping, chopping, and piercing purposes. We see also that some of the implements are very large and are shaped at one end like the beak of a bird of prey, and we realize what formidable weapons these would be in the hands of these savage and determined men.

Arrival of the Glacial Epoch

It is very necessary that they should possess such weapons, for every day and every night these people are in danger of sudden death from the fierce carnivorous beasts that lurk in the surrounding scrub and jungle. Also they have to provide themselves with food, and for this purpose they need large and heavy flints, equipped with a cutting edge, in order to dispatch powerful animals like the mastodon, that have been trapped in pits and other places. Around the encampment we see the remains of the creatures killed and eaten, and on one side, the ashes of a fire are visible, with several flints, cracked and reddened by heat, lying near it.

In the course of time East Anglia began to sink very slowly, and as the sea gradually encroached upon the land, the flint implements and other remains of man were quietly washed into hollows and depressions, where they were finally covered by great and widespread deposits of marine sands and shells. In the eastern counties of England these beds are known as "crag," and when visible in excavations of various kinds, their deep red color is one of the most arresting features of the landscape.

It is evident that as the land began to sink, the climate of East Anglia was growing colder, for an examination of the fossil shells in the crag has shown that, as we proceed upward from the lower

BEFORE ENGLAND WAS AN ISLAND

400,000 years ago man roamed on land that is now beneath the waves of the North Sea, East Anglia is shaded

and older to the upper and later layers of this bed, more and more cold-water molluscs make their appearance, until in the uppermost portions nearly all the contained shells are boreal species. This period of cold represents, in Suffolk and Norfolk, the beginning of the Great Ice Age, during which, at certain intervals—which were separated by warm inter-glacial phases of long duration—immense ice-sheets overflowed East Anglia.

Following upon the deposition, during the ice invasion, of the sands and shells of the Crag Sea over the ancient land surface of Pliocene times, the land began to be uplifted again, and thus the curtain rises on another remarkable chapter in the early history of our race. Thus, as the upheaval progressed, what is now the North Sea was banished far to the north of its present position. Then it was that the river Rhine flowed northward through a wide and shallow valley which is now occupied by the sea, and laid down its deposits of detritus upon the surface of the exposed beds of crag.

This material, deposited by the ancient Rhine, is known as the Cromer Forest Bed, and it contains a great number of the remains of trees that flourished in those remote days. An examination of the fossils contained in the Cromer Forest Bed has shown that the Rhine valley of that remote day was inhabited by herds of warmth-loving animals and it is therefore evident that the climate had once more become genial. The fossil bones and teeth of the great southern elephant, and *Elephas antiquus*—together with those of extinct sabre-toothed tiger, and of bears, numerous deer, horses and hippopotamuses—all of which have been found in the Forest Bed—testify to this return of warmth.

Finally there have been found at the very base of the Forest Bed, overwhelming proofs that prehistoric man inhabited the ancient Rhine valley, of which the present eastern slopes of England then formed a part, and the River Thames a tributary, and that he made his implements from the vast quantity of first-class flint that lay there ready to his hand.

These ancient Cromerians had evidently advanced considerably beyond the state of the still more ancient people who lived before the Crag was deposited. We know this because we see that many new and improved types of implements make their appearance in the more recently deposited Forest Bed. These specimens take the form of skilfully made choppers, points, and hand-axes, and are remarkable for their great size. Some of these implements weigh as much as seven and one-half pounds; while some were flaked for prehension, to the immense size of the hands of their makers.

No one with any knowledge of flint flaking can examine the Cromer specimens and fail to be impressed with the fact that the men who made them must have been capable of delivering blows of great strength and skill in the manufacture of their implements; nor to realize that they represent a very definite stage in the evolution of the human race.

Some years ago there was found at Heidelberg, in Germany, at a depth of about eighty feet from the surface, a massive human lower jaw-bone, which exhibits many distinctly ape-like characters. So large is this specimen that it is clear the individual to whom it belonged possessed almost gorilla-like proportions, and the interest in his fossil jaw-bone is enhanced when we learn that it was found in a stratum of the same age as the Cromer Forest Bed.

Here then, it would seem, we have part of the skeleton of one of the same race of men who made the great flint implements found in Norfolk, and who hunted big game in the great ancient Rhine valley several hundreds of thousands of years ago.

To stand upon the foreshore at Cromer, and visualize the vast changes in the earth's surface that have taken place since the days when man and the sabre-toothed tiger battled for existence upon a now deeply buried land surface, is to realize the profound antiquity of the human race. We do not know the exact number of years which these changes occupied, but we may be sure that it was immense, and that the earliest prehistoric men of East Anglia are separated from us who live today by a great and undoubted gulf of time.

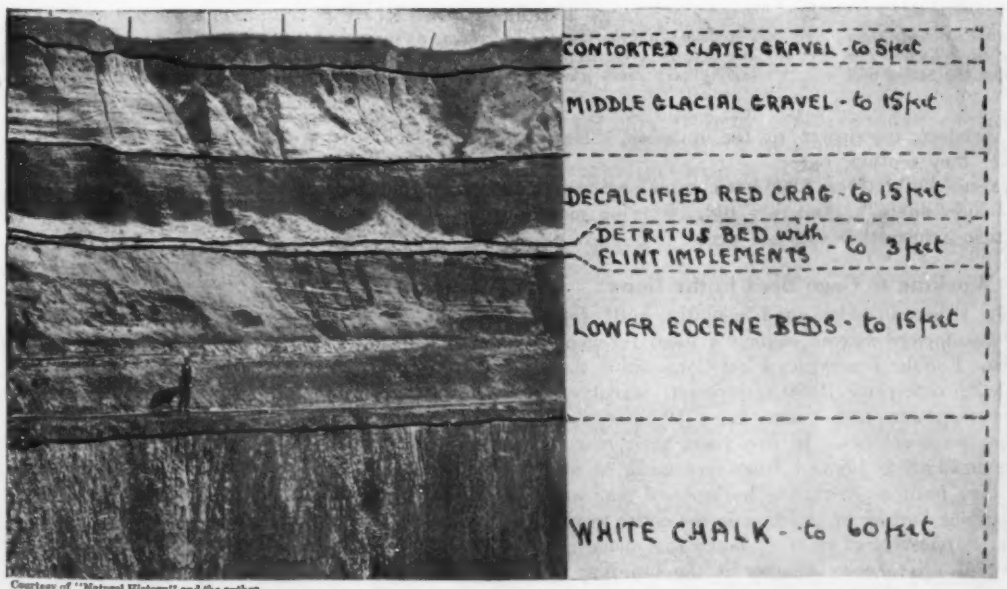
The Earliest Authenticated Evidence of Man

Before the author of the accompanying article began his researches we knew of the existence of man only in the glacial period; but now science has accepted the authenticity of human cultures found in strata that were formed before its beginning—that is, in the last, or Pliocene, epoch of the Tertiary Period of geology. These evidences are known, respectively, as the Foxhallian and Cromerian cultures and they have been worked out chiefly by Mr. Moir in southeastern England.

Courtesy of "Natural History" and the author

AMONG MAN'S EARLY EFFORTS AT TOOL MAKING

These implements, ranging in age from pre-glacial to early glacial, show cutting edges retouched by human hands


CONTORTED CLAYEY GRAVEL - to 5 feet
MIDDLE GLACIAL GRAVEL - to 15 feet
DECALCIFIED RED CRAG - to 15 feet
DETRITUS BED with FLINT IMPLEMENTS - to 3 feet
LOWER EOCENE BEDS - to 15 feet
WHITE CHALK - to 60 feet

Courtesy of "Natural History" and the author

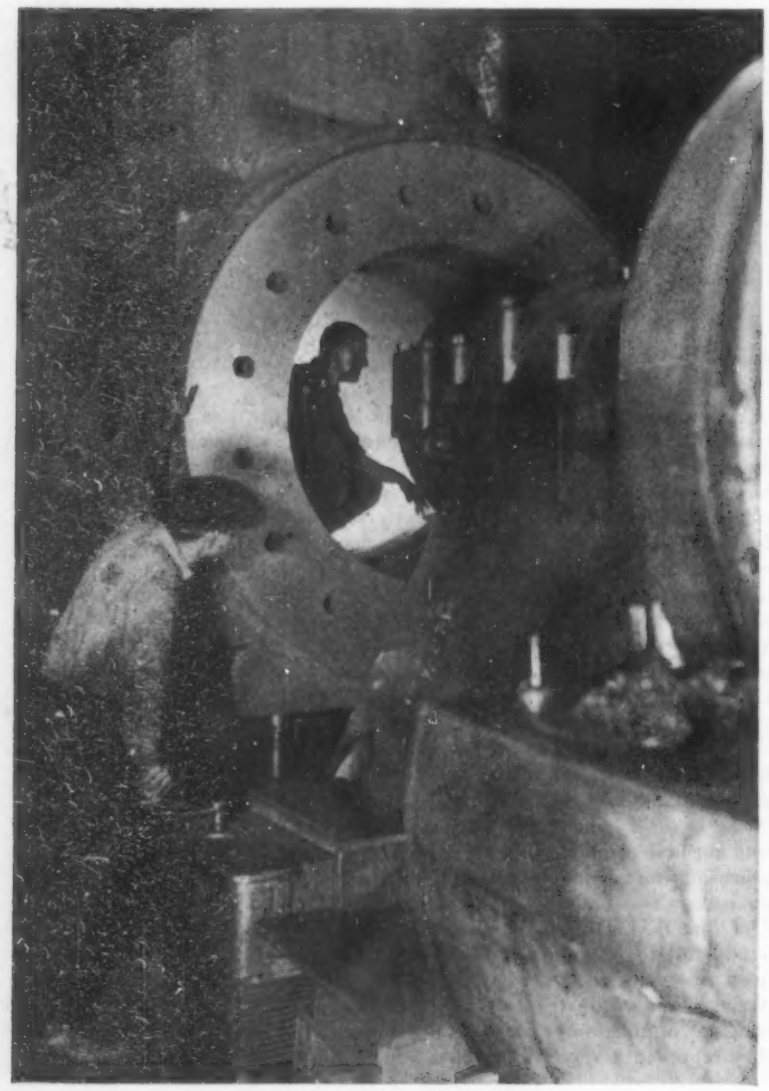
TWO VIEWS IN A GRAVEL PIT IN EAST ANGLIA. FROM THE DETRITUS BED MANY FLINT IMPLEMENTS CHIPPED BY PRE-GLACIAL MAN HAVE BEEN FOUND

Pliocene man lived, hunted and built his fires on the ancient land surface demarcated by the parallel ink lines near the center of the photograph. Later, the land sank beneath the waters of the North Sea and received a deep deposit of sand and shells, which is now called "crag." Later it was re-elevated. Mr. Moir appears in the right hand picture, at the left side

Machining Mountainous Masses of Metal

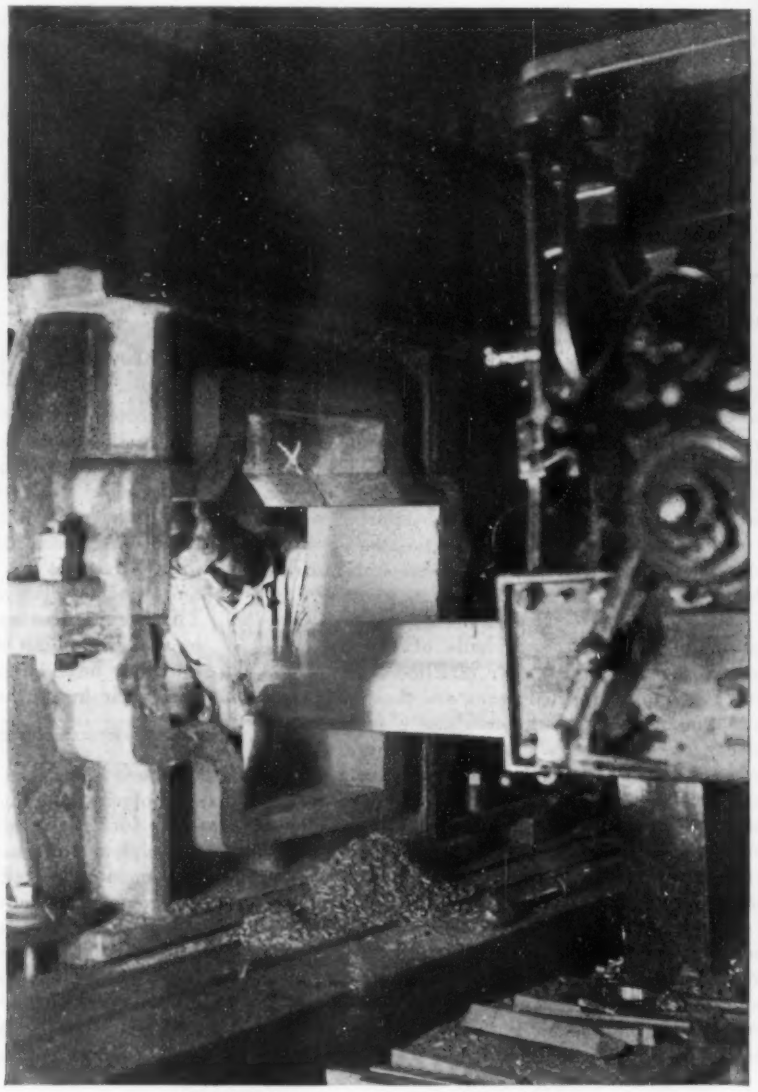
The Story of an Organization Which Possesses Gigantic Machine Tools and a Well-trained Corps of Workers and Which Puts a Just Valuation on Men as Well as Machines

Photographs made in the plant of The Hooven, Owens, Rentschler Company, Hamilton, Ohio, by Scandlin



LOOKING AT THE FINAL CUT

This has been called by experts one of the finest industrial photographs ever made from an art angle. They have just finished the machining of the inside of a gas cylinder. The workman has crawled in for a last look before the cylinder is lifted from the boring mill



THE PHANTOM ARM OF SOLID STEEL

This tool is a draw shaper. The photograph was made as the tool was working, the large arm holding a cutter in its steel fingers and scraping a thick shaving of iron from the casting each time—a shaving that is measured to thousandths of an inch in thickness

THERE is something about the handling of large masses of metal, of transforming the visions of engineers into the huge engines and "fine realities of steel and iron," that fundamentally affects men and organizations. In the shop where the photographs on these two pages were made, are some of the biggest tools in the world. Big jobs are done as part of a day's work and size in itself loses its own significance.

For example, when the exigencies of war demanded marine engines, these men told the Shipping Board they could build 2,800-horsepower marine engines—though they had never had experience on marine work, and had never built an engine for a ship.

"How many can you build?" the Board asked.

"Two a week—indefinitely," said the clear-eyed engineer.

The impossibility of this was pointed out. They were asked to check and revise their figures. At the next meeting, in answer to the question, "How many?" they replied:

"We can build three 2,800-horsepower engines a week—indefinitely." And they did. It is of such stuff that industrial heroes are made.

Working to Gage Bred in the Bone

They received orders and actually built *four 2,800-horsepower marine engines a week* for many months. For the Emergency Fleet Corporation they completed ninety-one 2,800-horsepower, seventy-six 1,400-horsepower and twenty-five 750-horsepower marine steam engines. In five years their marine engine production jumped from zero until, in one year, they built more marine horsepower than any other engine builder or shipyard in the entire world.

That is one typical story of many that make the history of this shop. Another is the building of Henry Ford's 60,000-horsepower plant at Detroit. This plant is operated by means of a combination of gas and steam engines.

Their machinists are mostly sons of machinists whose fathers were machinists too. Working to gage is bred in the marrow of their bones. They learn instinctively, or are taught, to look beyond the job to the purpose. A man does not machine a shaft so much as he helps to build a sugar mill or a great engine.

Ask the man on the lathe what he is doing and he may tell you how vital the part is in the Diesel engine he is making. With this spirit from the top down and the bottom up meeting and fusing, the details of machine shop practice become of secondary importance.

Multiple machining made possible by big tools is one of their open secrets. Another is the quick scrapping of even good tools whenever a new tool is developed of sufficiently increased efficiency to justify the change. It is an upsetting, disturbing policy—but its value is certain. It permits a continual increase in production without the corresponding addition of floor space.

Some of the figures are significant. The crane equipment necessary to move the masses of material aggregates 543 tons capacity. One of their most interesting tools is a fifteen-foot planer equipped with four motor-driven heads. This planer is the heaviest and most powerful in the world. Among their thirteen huge boring mills are twenty-four-foot and twenty-foot ones. In the foundry, castings weighing from forty to fifty tons are made so frequently that they are just ordinary features of the day's work. A single casting they made for an engine bed weighed 166,000 pounds.

Naturally, where such large jobs are done, the timing of parts and processes, the routing through the shop, even inspection must be done on rigid schedules to avoid jams. Some tools run on tracks to facilitate quick work. Other tools are portable. They are lifted by the giant cranes and carried to the work. To give some idea of the variety and size of work done in this plant, here is a partial list of present production:

Forty-six plate glass tables, thirty-six feet in diameter, each weighing approximately one hundred tons. An 8,000,000-gallon steam-driven pump. A steel rolling mill order aggregating 4,000 tons consisting of eighteen-inch, forty-two-inch and thirty-two-inch rolling mills and tables. One 3,300-horsepower and two 1,500-horsepower Diesels. A twenty-one-roll sugar mill, the largest ever built, with a capacity of 4,000 tons a day. It will weigh about 2,000 tons. A number of simple and cross compound and tandem Corliss, Uniflow and Poppet Valve steam engines.

Great Variety of Production

This variety of production carries their products into practically every human business activity. The water you drink may be brought to you by an engine and pump built by this plant. The sugar you drop into your morning coffee may have been ground from the cane in a sugar mill driven by these great engines, all built in this plant.

Sculptors in Steel and Iron

When you come to New York and stop at a big hotel—the Pennsylvania, for example—a Hamilton engine down in the basement is running the generator that produces the electric light for your room.

The frame in your automobile may have been pressed by a gigantic Hamilton press (they make the biggest there are to be had) while the oil may have been transported by a tanker driven by these engines.

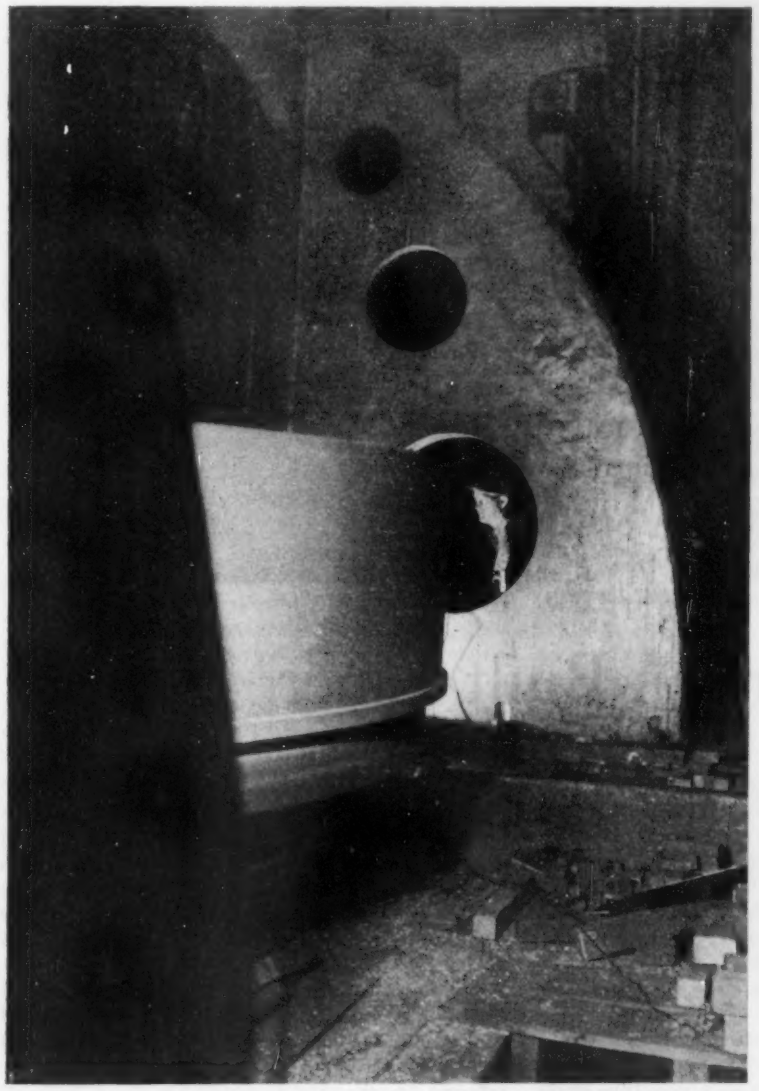
If you care to, you may visit this plant on a tour of inspection and see these giant engines in process of fabrication. The company makes no secret of their methods and welcomes visitors who come with a genuine interest in the work which they are doing.

But all the mechanical experts of the plant, their system of working, their service in every phase of industrialism on land or sea, seems little compared with the human element in the shops. They cultivate and cherish men much more than tools or systems. When the son of a machinist is old enough and ready for work, he is brought into the shop. Half the day he studies in a school—the other he learns to put into practice the theories taught him in the school. He is paid a salary from the start and when, after a definite time, he is "graduated" from the school, he takes his man's place at the bench or lathe, with the filled tool box he has earned as part of his course. It is easy to understand how this system would produce a personnel composed of men who have a genuine interest in and love for their work.

Some reference should be made to the camera studies made in this plant by Scandlin. We show but four. Most of them were made at night. There are many others, some of which have been pronounced by the experts to be the finest industrial "camera paintings" ever made.

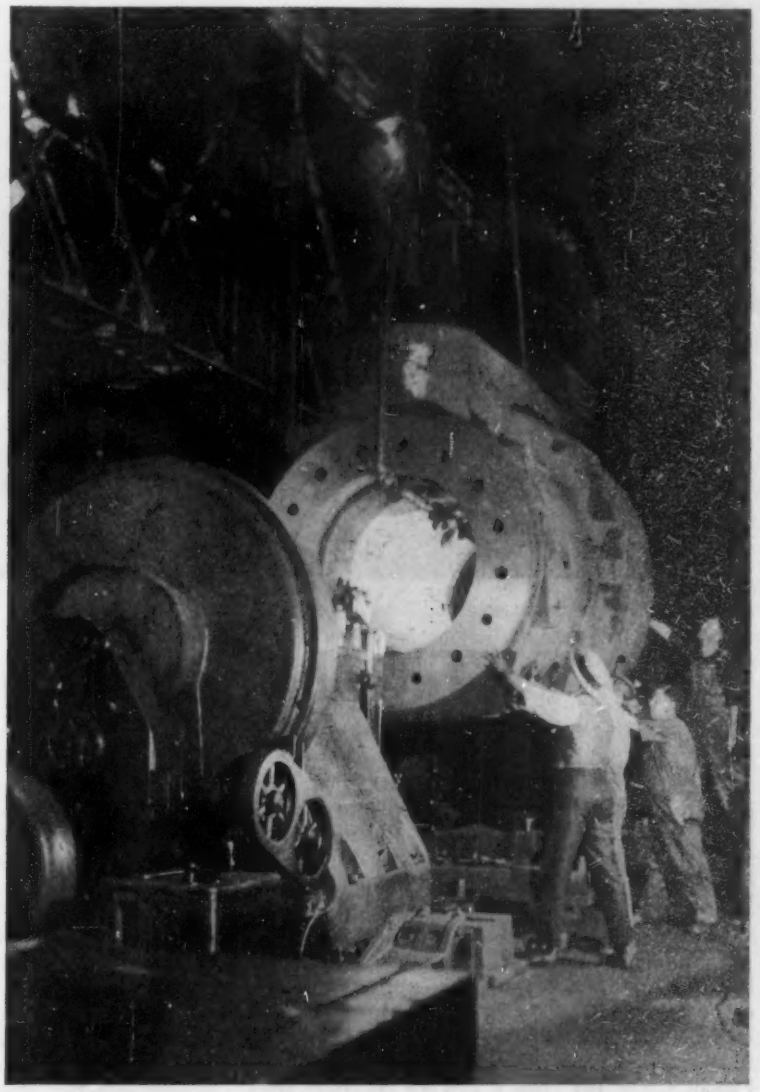
In these pictures, something of the shop and the men in it, lives and grows. You feel the artist in the artisan—the creative spirit of these "sculptors in steel and iron" who seek beyond the beauty of form to the beauty of perfect usefulness.

And there is indeed truth and beauty in a running engine, a strange fascination in the to and fro motion of such mechanical perfection. This is only gained by shop technique of a high order.



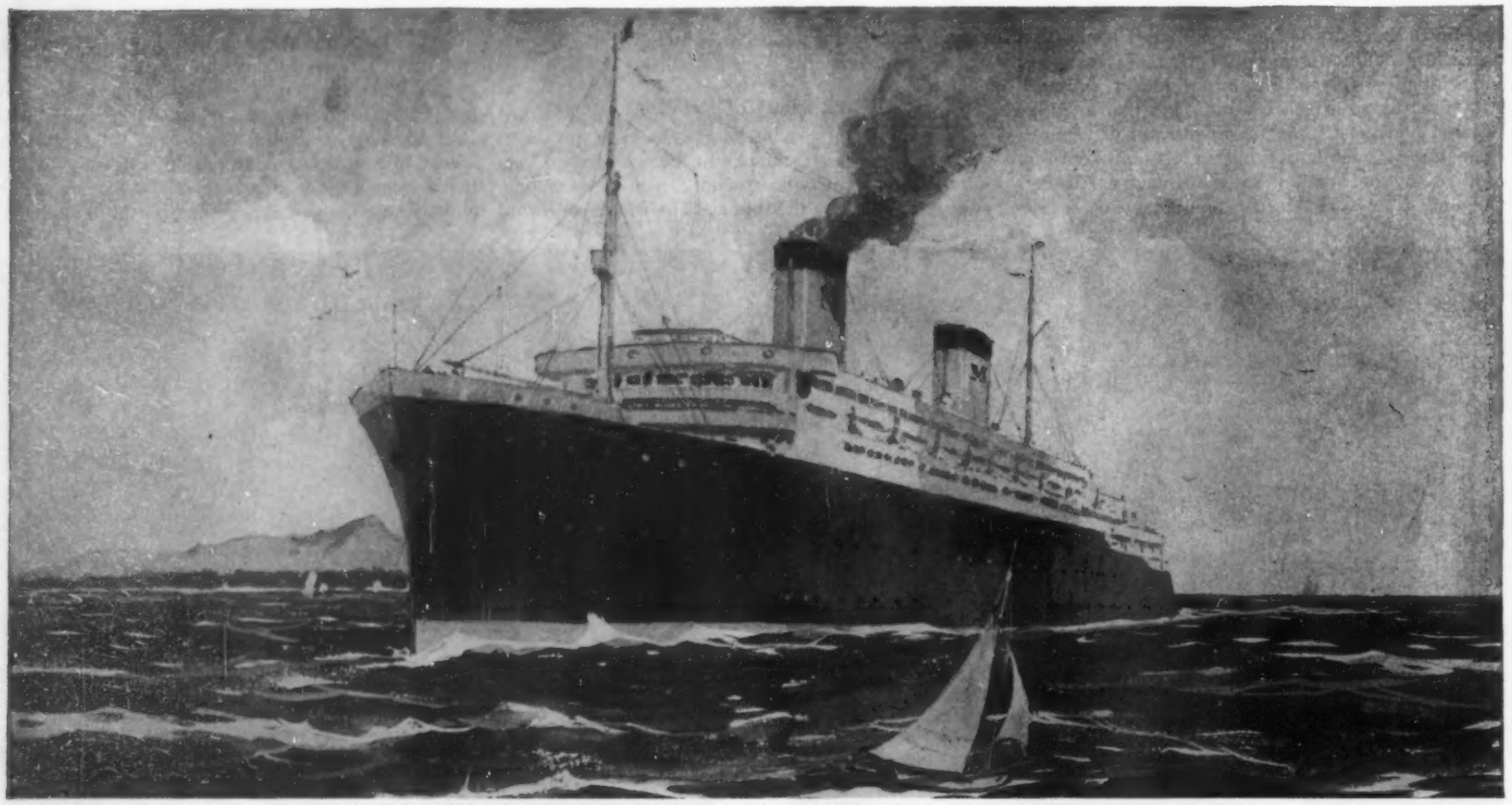
LIVING LIGHTS AND STRANGE SHADOWS

This huge boring mill towers as high as a house. We are looking at it from the rear. A workman has stopped for a moment to watch the tool at the working point—when the metal cuts metal as a steel plane shaves wood. This is a flywheel for a Corliss engine



A TOOL THAT CUTS BOTH WAYS

They are removing a gas cylinder from a horizontal boring mill. The mill machines two ways at once—at a perfect right angle. It is large enough to take a casting of any size. In this plant they made a single casting weighing 166,000 pounds



THE "MALOLO" WILL BE THE FASTEST AND LARGEST LINER EVER BUILT IN THE UNITED STATES

The Largest American-Built Liner

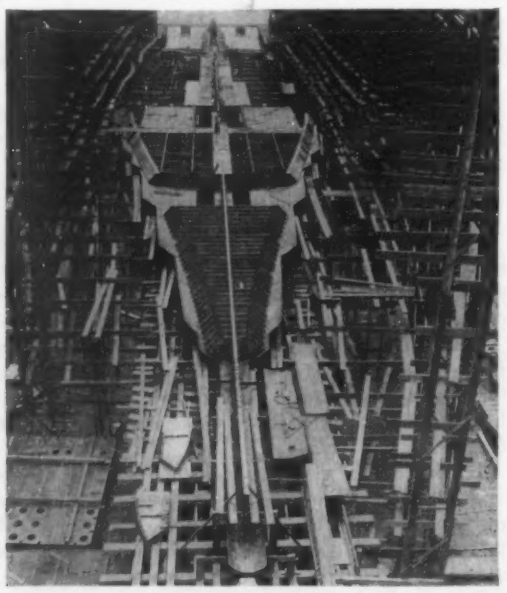
The "Malolo" Will Exceed in Size, and Speed Any Previous American Ship

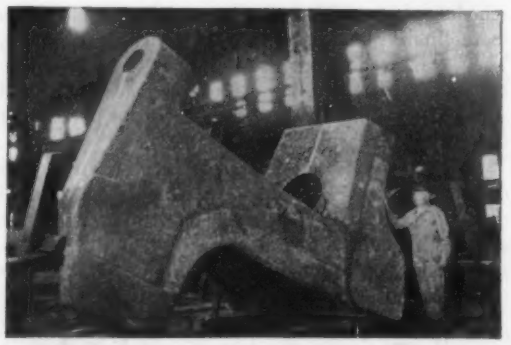
THERE is now being constructed at Cramp's Ship Yard, Philadelphia, a passenger liner which, upon its completion in 1927, will surpass in size, speed and luxurious accommodation any American-built passenger liner.

The *Malolo*, as she will be called, will have a length over-all of 582 feet, a beam of 83 feet and a displacement of 22,050 tons on a draft of 28 feet 6 inches. She is designed for a speed of 22 knots, with 25,000 horsepower. Her designer, Mr. William Francis Gibbs, has made a striking departure from the conventional proportions of a ship of this class. Hitherto, deep-sea passenger ships have been characterized by moderate beam and deep draft; but Mr. Gibbs has designed the *Malolo* with unusual beam for her length and a moderate draft. Thus, the *Mauretania*, with a length over-all of 790 feet has a beam of 88 feet and a draft of 30 feet, whereas the *Malolo*, which is 208 feet shorter, has a beam that is only 5 feet less than that of the *Mauretania* and her draft is 5½ feet less, or only 24½ feet.

Steam will be furnished by a battery of 12 water-tube, oil-burning boilers, which will carry a continuous working pressure of 280 pounds of steam per square inch. This is in line with the present-day tendency, which is toward higher boiler pressures. In fact, so far as we know, this is the highest working pressure ever used on a passenger steamship. The power is developed on two propellers, 19 feet in diameter, which will be driven by two sets of turbines, each with a high, intermediate and low-pressure chamber. The reduction gear will be of the mechanical type, with a ratio of 12 to 1, the turbines running at 1,500 revolutions per minute and the propellers at 125 revolutions. The reduction gears, which are being built by the De Laval Steam Turbine Company, will consist of one main gear with one high-pressure and one low-pressure pinion mounted in the gear case.

The *Malolo*, which is being built for the American-Hawaiian Steamship Company, is well protected against disaster by means of double bottom and bulkhead protection, and a large pumping capacity sufficient for the ship to pump 146 times her own weight of water per day. In luxury she will be the equal of any Atlantic liner. There will be an indoor and an outdoor motion picture theatre, a swimming pool, a laundry that will call and deliver to passengers daily, a barber shop for the crew, a gymnasium, the largest number of private baths ever built into a ship. To crown all, there will be a soda fountain, with a specially trained, deep-sea, "soda jerker," who can concoct any soft drink that can be named.





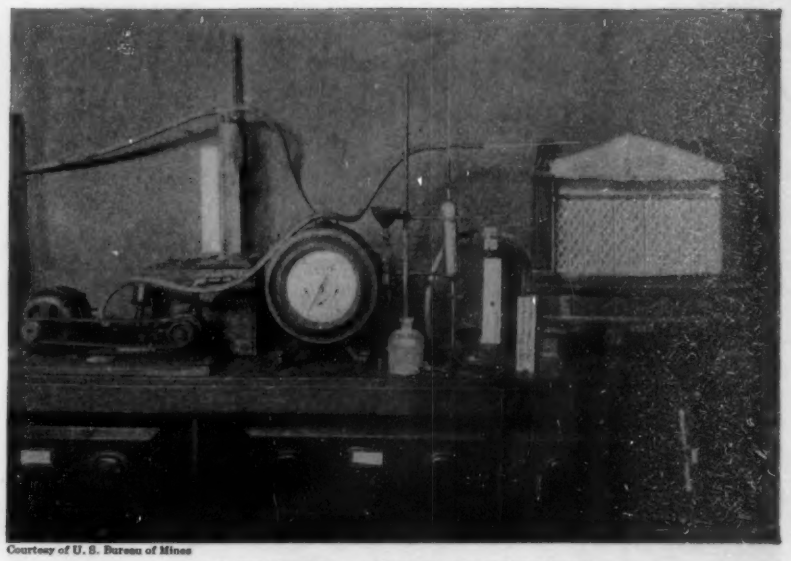
DETAILS OF THE "MALOLO"

LEFT: *U-shaped keel and vertical keel.* CENTER: *Building the double bottom. Note the broad beam and fine lines of entrance.* RIGHT: *The twenty-ton, steel, stern casing*

Courtesy of U. S. Bureau of Mines

THE EXPERIMENTAL GAS CHAMBER

While the subject is exposed to carbon monoxide, frequent tests of his blood are made



Courtesy of U. S. Bureau of Mines

GAS HEATERS A SOURCE OF POISONING

Apparatus to test effects of carbon monoxide escaping from defective natural-gas heaters

The Peril of Gas Poisoning

The Bureau of Mines Investigates the Poisonous Action of Carbon Monoxide

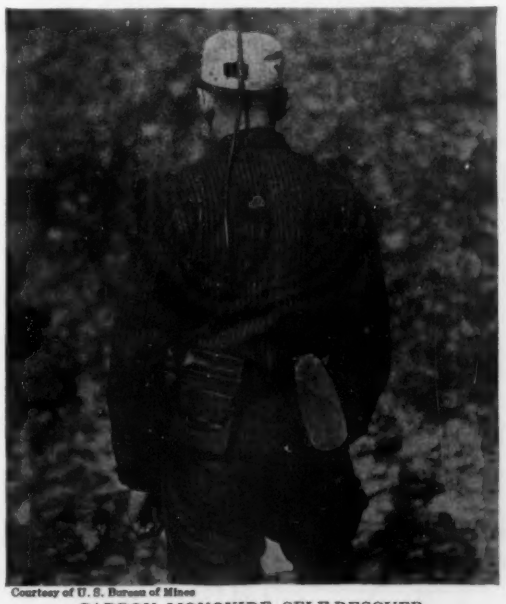
TO a certain degree, the precautions which are recommended for use as a protection to the health of the community may be likened to a protective earthworks or stockade which is thrown up around the life both of the individual and of the community in which he lives. The hygienic laws which have been formulated during the last generation or two are among the most human and noblest achievements of contemporaneous civilization; for back of these laws lies a vast amount of patient, highly intelligent, very laborious and too-little-acknowledged work by bands of devoted men, whose rewards must consist chiefly in the satisfaction over a great work well done.

We have before us some reports sent out by the Bureau of Mines of investigations which they have made during the past few years on the important subject of poisoning by that insidious gas, carbon monoxide—a gas which is a product of incomplete combustion. The peril of the gas lies in the fact that it is without color, odor or taste; and, therefore, may exist in dangerous quantities without its presence being suspected.

Blood Samples Taken During Tests

It will be remembered that in making recommendations to the New York and New Jersey Tunnel Commissions, Dr. Henderson and his co-workers advised that, if the vehicular tunnel be so ventilated that persons passing through the tunnel would be exposed to not more than four parts of carbon monoxide in 10,000 parts of air, for not longer than 45 minutes, they would experience no ill effects. Supplementary experiments carried out by Messrs. Sayers, Meriwether and Yant, of the Bureau of Mines, at the experiment station at Pittsburgh, substantiated these findings. In this investigation, experiments were made in a gas chamber where the conditions could be accurately controlled, when the effects investigated were: (1) the effect of long exposure to low concentrations of carbon monoxide; (2) the effect during exposure of strenuous exercises; (3) the effect, lastly, of high temperature and humidity in low concentrations of carbon monoxide.

Exposure of blood to two parts of CO in 10,000 of air, as calculated by Henderson, may possibly produce 28.5 percent saturation of hemoglobin when equilibrium is reached; exposure to three parts in 10,000 is calculated to cause 37.4 percent saturation when equilibrium is reached; while four parts, according to his calculation, will produce 44.4 percent saturation. Henderson presupposes that the affinity of CO for hemoglobin is 300 times that of oxygen for hemoglobin. He further uses 15 percent as



Courtesy of U. S. Bureau of Mines

CARBON MONOXIDE SELF-RESCUER

This compact outfit provides the wearer, if caught in an emergency, with one-half hour's supply of oxygen

being the concentration of oxygen in the air of the lungs. He does not claim that the figures used are more than approximately correct but that they are sufficiently accurate to indicate what might take place. He also calls attention to the fact that many hours of exposure are required and that the time is really indeterminate before the circulating blood would come to equilibrium with the CO in the air.

The investigation at the Pittsburgh station took place in a specially constructed gas-tight chamber. The "work" was done on a bicycle ergometer and calculated as foot-pounds. In conducting the tests, examination was made of the body temperature, pulse, respiration and general condition of the subjects before they entered the chamber. During the test this was repeated, with the addition of the taking of blood samples to determine the rate of absorption of the carbon monoxide.

The ultimate conclusions of the test were:

1. The combination of CO (carbon monoxide) with hemoglobin takes place slowly when the subject is exposed to low concentrations and remains at rest, many hours being required before equilibrium is reached.

2. The rate of combination of CO with hemoglobin takes place much more rapidly during the first hour of exposure than during any succeeding hour, with the subject remaining at rest.

3. Strenuous exercise causes much more rapid combination of CO with hemoglobin than when the subject remains at rest. The symptoms of CO poisoning were emphasized by exercise while the subject was in the chamber.

4. High temperature and humidity, with a given concentration of CO, cause more rapid combination of CO with hemoglobin than do normal conditions of temperature and humidity.

All symptoms and effects described are called acute in character. None of the subjects has shown any permanent deleterious effects from the exposure to CO.

Gas Heaters Must Have Flues

The Bureau of Mines has also made a valuable contribution to our knowledge of the risk of carbon-monoxide poisoning due to the use of natural-gas heaters in the Pittsburgh district. In every case listed in the tests, none of the heaters was connected to a flue, its combustion products being liberated directly into the room. The Bureau found no fatalities from natural-gas heaters, where a flue or a fireplace was provided.

The investigations of carbon-monoxide fatalities in that district are to be continued. The people at present are obliged to rely upon the honesty of the manufacturer and dealer as to the safety of heaters sold; and the report closes with the statement that "many of the heaters sold are recommended for use without flue connections; but to use them as recommended would be decidedly dangerous."

BARBER-SURGEONS OPERATING ON PATIENTS

In the Sixteenth-Century operating room depicted in this old woodcut, surgery amounted to brutality, and the barber was the surgeon. Science had not yet found a better way

Price & Company

A MODERN OPERATING THEATER

Demonstrations on the diseases of the throat are being given to medical students. Antiseptics, anesthetics and modern surgical skill add greatly to the patient's chances

The Progress of Medical Science—IV

Serums, Vaccines, Surgery, and the Outlook for Prolonging Life Through Hygiene

By Morris Fishbein, M.D.

Editor, Journal of the American Medical Association, and of Hygeia

PASSING from drug therapy for a moment to the use of serums and vaccines, we come to a field that has been subjected to much abuse and exploitation, not so much by physicians as by the commercial purveyors of these products, who have by their wholesale advertising propaganda in many instances misled the physician. The untrained man, who was not familiar with the possibilities in this field, unfortunately has used such substances in instances in which they could not possibly have any effects, or in which their beneficial effects had not been demonstrated.

However, almost anyone who is able to study and evaluate scientific evidence would not hesitate for a moment to accept the evidence that diphtheria antitoxin has specific preventive and curative value in that disease, and that the serums for use in meningitis, tetanus or lock-jaw, and cholera have adequate beneficial virtues. Almost anyone who can evaluate evidence would not hesitate to approve the use of anti-typhoid vaccination in the prevention of typhoid fever, or of vaccination for preventing smallpox and hydrophobia.

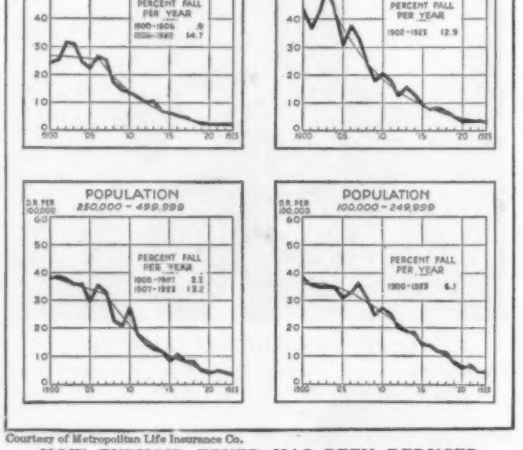
Some Gland Extracts are Failures

However, pneumonia, influenza, tuberculosis and many other complaints have not yet yielded completely to the attack of biologic preparations. There is evidence that specific serums or vaccines may be of virtue in isolated instances, or if used in certain ways, but the evidence is not in any way comparable to the thoroughly established use of these products in the diseases that have been mentioned.

Consider next the uses of preparations made from the glands within the human body. Of insulin, there is no longer any doubt. The use of thyroid extract in cases in which the thyroid is insufficient produces results that are striking and to the uninformed actually marvellous.

On the other hand, there remain a large number of conditions apparently due to deficiencies of glandular substances in which administration of extracts of the glands does not yield any satisfactory return. Attempts have been made to overcome these deficiencies by the giving of mixtures of glands or of gland substances prepared in a special manner, but all of this is experimental. It is merely, perhaps, a well warranted trial, sometimes of virtue, but in many instances of little value. Certainly, it is in no way established as scientific facts must be.

The power of the physician to overcome disease is not limited by any single method or by any narrow



Courtesy of Metropolitan Life Insurance Co.

HOW TYPHOID FEVER HAS BEEN REDUCED

These falling curves offer a remarkable proof of the value of sanitation

conception of disease causation and pathology. He need not rely on drugs alone, or on biologic products alone. He may carefully apply methods for changing the entire metabolism within the body; by carefully regulating the diet, he may stimulate disposal of wastage. He may throw greater burdens on certain organs and diminish the burdens of others. By increasing the blood supply to certain parts of the body through the use of heat, as applied by any one of several methods, for four or five minutes, he may stimulate that portion of the body to increased activity; by the use of cold, he may lower the rate of action in certain portions.

He may avail himself of all of the effects of physical agencies, such as massage, light, water, exercise, diet, electricity and what-not in producing improvement which has been known to follow the application of any one or all of these procedures.

Painless Surgery Is Quite Recent

The surgery of a century ago was a painful and almost brutal procedure. With the coming of antisepsis and later of asepsis, following the work of Lister and Pasteur, the mortality which resulted from surgery was greatly reduced through the elimination of bacterial infection following operation.

With the development of anesthesia, beginning with the work of Morton and Long on ether, and following with chloroform, nitrous oxid-oxygen, gas, stovain and intraspinal anesthesia, the use of narcotics preliminary to operation to reduce the patient's sensibility and, more recently, the development of another gas anesthetic, ethylene, physicians have been able to work more slowly, more carefully and more accurately, extending surgical procedures to organs heretofore unapproachable by the surgeon's knife, thereby saving many lives in conditions previously called inoperable.

Moreover, continued study of nerve routes and nerve paths, with the development of anesthetic substances which may be applied directly to nerves, permits effectively blocking the sense of pain which may proceed along the nerves to the brain. So-called local anesthesia with such drugs as procain and butyn enables surgeons to operate on patients who are fully conscious and therefore are better able to resist the shock which may accompany extensive operative measures.

Whereas operations were formerly limited to amputation, or to the hasty removal of such diseased tissues as an inflamed appendix or of a gangrenous

ovary, the modern surgeon enters the abdomen for the removal of masses of diseased tissue of great weight. He performs plastic operations within the abdomen, removing whole sections of the bowel, parts of the stomach and such organs as the kidney, spleen or gallbladder.

Studies of the physical mechanisms involved in breathing, with the construction of adequate pressure chambers, permit operation within the chest cavity, and quite recently investigators in Boston were able to introduce a tube directly into a beating heart and to cut one of the valves which had been so constricted by disease as to menace a child's life.

The brain, practically unapproachable in a previous century, is now the subject of operations for the removal of tumor, for the relief of abscess, and for other conditions which formerly meant certain death. Indeed, here diagnosis includes photography of the structure of the brain, accurate measurements of the pressure within the brain, and careful neurologic tests of sensation and function of parts far removed from the brain by which it is possible to localize, almost to a hair's breadth, growths within the brain before the skull is opened.

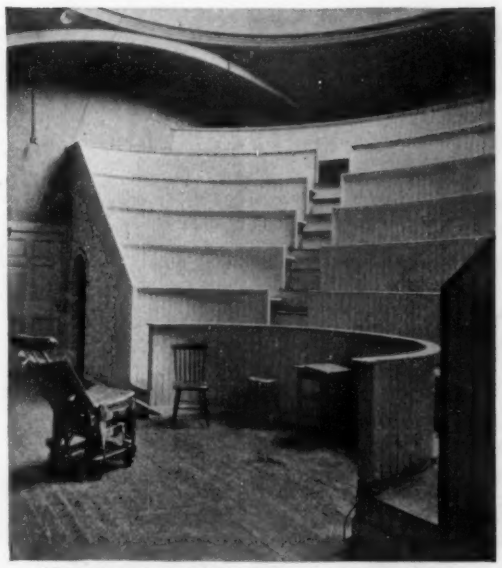
These marvels of scientific surgery are again not theory, but operations that have been performed and scientifically recorded.

Cancers Must Be Treated Early

As has already been mentioned, the attack on cancer through research as to its cause is beginning to build a narrowing hedge of facts which will sooner or later sift out the primary cause. But in the treatment of cancer medical science has gone even farther. Thousands of surgical operations on cancers diagnosed early in their course have yielded positive proof that complete removal at such a stage prevents recurrence and not only greatly prolongs life but may actually yield cure.

In the attack on cancer the physical agents also have been called into play so that electricity in the form of diathermy and the cautery may be applied to advantage to kill cancer cells and to seal off the tissues which may be invaded; the apparently specific effects of high-voltage X rays may be applied to destroy cancer cells and to inhibit the growth of new cells, and radium in the form of the substance itself and of radium emanation may be used in certain instances to produce actual cures of cancer.

The primary emphasis must be laid, however, on the fact that cancer must be seen and diagnosed early. After the tissues have been invaded and after the cancer has spread from the first point of origin to neighboring tissues and in some instances throughout the body, remedial attempts are usually hopeless.



AN OLD-TIME OPERATING AMPHITHEATER

The patient was strapped to the operating table. No anesthetics existed. Arrangements for preventing infection were crude

The death rate of tuberculosis has been reduced by more than one-half; typhoid fever no longer menaces communities which are willing to pay the price for good milk supply, good water supply and proper sewage disposal; inspection of fresh and prepared foods has practically abolished the menace of diseases formerly transmitted in this manner.

Special attention given to the problems of infant mortality has reduced the death rate in the earlier years of life and an infant coming into the world today has a far greater expectancy of life than did one coming into the world fifty years ago. The child that might then have expected to live to somewhere between thirty-five and thirty-nine years of age may now confidently look forward under all ordinary circumstances to reaching the age of fifty to fifty-five years. What hope, then, of giving that child an opportunity to reach its allotted three score and ten?

The diseases that still remain to cut down the human being at an age previous to the time when he might reasonably expect to depart this life through the actual wearing out of the machinery which is no longer able to renew itself, include at this time particularly the diseases of the heart, blood vessels and the kidney. Such conditions as Bright's disease, a chronic inflammation of the kidney, as hypertension exemplified through high blood pressure and the symptoms that accompany it; as arteriosclerosis, or hardening of the arteries; as angina pectoris and inflammations of the lining of the heart and of its valves—all such conditions constitute a problem which the medical profession must meet and which it apparently cannot meet properly without the complete education and the intelligent coöperation of the public.

Here are diseases whose prevention seems to lie in the prevention of the infections of the throat in childhood; in the training of the child and man in the proper hygiene of the nose, throat and intestinal tract; in the teaching to the adolescent and equally to the adult of the desirability of a quiet, well-ordered existence with a proper amount of food, of exercise and of rest; and not the least by any means, in letting people know that there is such a thing as mental hygiene, including relief from worry or mental strain.

Can We Keep Up Our Progress?

And then there is pneumonia, a disease likely to affect the older man much more severely than the young one, called, indeed, "the old man's friend" for the quick death that it produces in the senile, and the "captain of the men of death" for its severely fatal character. The complete conquering of this infection seems somehow to be resting on the threshold of the future.

It is the belief of several competent statisticians who have given careful consideration to the matter, that when these diseases are brought under control, the life expectancy will be moved forward at least another five years, but probably not a great deal more.

The trend of modern life seems to be toward speeding up, toward greater mental strain and almost ceaseless activity. If, coincident with such speeding, medical science is still able to promise another five years of life expectancy to the phenomenal numbers of years that have thus far been added, it will have accomplished a marvel beyond the dreams of the medical scientists of fifty years ago.

The progress of the last fifty years has been a pace maker which the centuries to come will find difficult to follow.

General Photographic Agency, London

OXYGEN ROOM IN A BRITISH HOSPITAL

In many diseases, notably pneumonia, patients find it difficult to breathe sufficiently to supply the oxygen need of the body. Therefore oxygen is artificially supplied

General Photographic Agency, London

DEEP X-RAY THERAPY

X-ray apparatus with high voltage permits maximum penetration over short periods and is used for treating internal cancer. This invaluable method is comparatively recent

A MACHINE FOR EXAMINING DETAILS OF SPEECH

The kymograph is used at the University College, London, to examine details of speech, peculiarities of dialect and to diagnose defective speech

AN APPARATUS CALLED THE "LIORETGRAPH"

This device is used to enlarge phonograph records. Some interesting discoveries made by the use of this instrument are described in the following article

Seeing Our Speech As Others Hear It

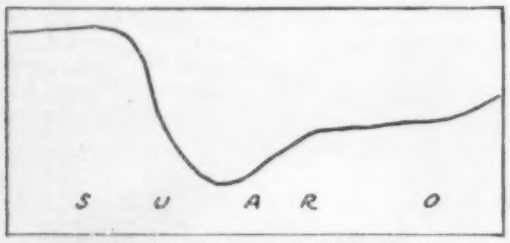
An Instrument Which Records the Various Attributes of the Human Voice

By Stephen Jones

Phonetic Laboratory, University of London, University College

THE statement by Albert A. Hopkins in the Scientific American for February, 1925, that "among all the domesticated animals man is the one, it seems, about which we know least," possesses a deep significance. To this one is tempted to add the corollary—that what man is most ignorant of is his own manner of speaking. One is almost convinced of this when listening to speeches broadcast over the radio. It is certain that if speakers were confronted with their own deviations from what is considered good English, they would vigorously deny ever having uttered them. The following are but a few of the curiosities which have been noted from time to time:

A distinguished scientist, speaking about the structure of the atom discusses "the complex phenomenar inside it." While an English Cabinet Minister with an Oxford accent deprecates "the idear of fighting." A well-known singer assures us in his most convincing top-notes that "Sylviar is excelling,"

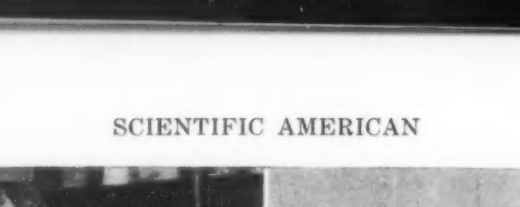


AN APPARENTLY HARMLESS WORD

FIGURE 3: *"Suaro" in the Indian vernacular means "troopers"*

and a Shakespearian actor taking the part of Quince in *Midsummer Night's Dream* announces that he would "drawr a bill of properties." Further we are told by an official in a broadcasting station—presumably chosen for his good English—that he is "growingg old," while another relieves us of much anxiety by informing us that a certain well-known person is "on terra firmar again."

The case of a person learning a new language is very interesting. He tends to hear what he is accustomed to hear; and consequently, he pronounces sounds in the new language as he would pronounce those of his own language which most resemble them. Certain foreigners, for instance, in speaking English, make no distinction between a "small bath," a "small bass," and a "small bus." In any English-speaking country, such a pronunciation could not but lead to disaster.



ANALYSING SPEECH BY THE KYMOGRAPH

FIGURE 1 (upper): *"Tea" as pronounced by an Englishman.*
FIGURE 2 (lower): *"Tea" as pronounced by a Frenchman*

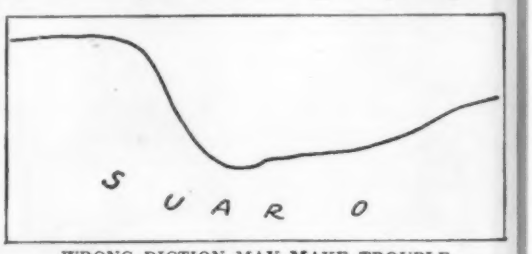
It is a strange but undeniable fact that the human mind is prone to postpone judgment when confronted by subjects of everyday occurrence. Generally, it never strikes one that these subjects merit consideration. They are taken as a matter of course; for, like the poor, are they not always with us? The very frequency of a familiar event dulls us to its importance. There is a curious elusiveness about familiar things. And what can be more familiar than speech?

Just as science corrects the defects of sight by lenses and deafness by acoustic devices so, by the aid of specially devised instruments, certain attributes of speech sounds which formerly escaped the ear can be brought into prominence and relief.

It is the purpose of this article to describe such an instrument, an instrument which serves to render the attributes of speech sounds, such as their duration, pitch, timbre and intensity, visible to the eye. That the eye is a help in the recognition of speech is known to many. How great that help may be is realized by few. The facility with which many deaf people are able to read lips is a remarkable example of how the eye may aid the ear.

Dr. Schuman, an authority on speech defects, goes so far as to say that the exercise of the function of speech on the whole frequently proceeds from its optical constituent. How important it is, therefore, that the visual representation of speech properties should not be overlooked or underestimated.

Instruments used for the visual representation of speech should be of great accuracy and delicacy, for important significance may be involved in some of the minutest details. How infinitesimal these details can be is shown by the following facts. It has been computed that during the act of speaking, pressure changes of less than a millionth of an atmosphere occur. Expressed in another way, this would be equivalent to the weight of a section of human hair one-thousandth of an inch long, that is, about one-third as long as it is broad. Cornet playing, we know, is a vigorous pastime. Yet, if ten million cornet players were to play *fortissimo*, they would only emit one horsepower of sound. How much less then must be the rate of expenditure of energy in speaking.

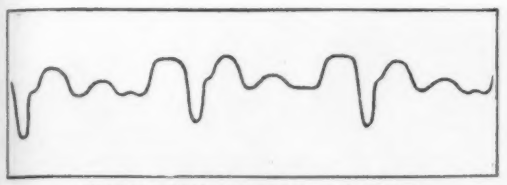


WRONG DICTION MAY MAKE TROUBLE

FIGURE 4: *"Suaro" mispronounced sounds like "Swine"*

The instrument shown in the top left-hand illustration on this page is called a "phonetic kymograph"—a name derived from two Greek words meaning "wave" and "writing." It was made by Mr. C. F. Palmer, Engineer (London) and consists essentially of two parts: (1) a surface to be recorded on and (2) sensitive recording points.

The surface is an endless band of glazed paper which is carried by one or two cylinders that rotate on parallel horizontal axes. On the paper is de-



GRAMOPHONE RECORD ENLARGED
FIGURE 5: *A note of a tuba magnified 350 times*

A LIORETGRAPH SPECIMEN
FIGURE 6: *The vowel "o" as in the word "born"*

posited, by means of a broad gas flame (impregnated with benzol), a thin layer of soot. The driving mechanism is an electric motor. The recording points are mounted side by side on a horizontal rod, which is furnished with a fine screw adjustment. This rod is clamped parallel to the axes of the cylinders. When the duration of a syllable or word is needed, a recording point, which is attached to a small electromagnet, is used. It records simultaneously with the other recording points. The electromagnet is actuated by an electrically driven tuning-fork, the frequency of which is a hundred complete vibrations per second. Intervals of time to less than the two-hundredth part of a second can in this way be estimated with ease. Other tracing points, which record vibrations issuing from the mouth, nose and larynx, can be employed. These tracing points consist of thin flexible strips of bamboo or celluloid. They are attached to the extremity of straw levers and give suitable magnification. The levers are supported in the centre of a sensitive vibrating membrane of thin rubber, or skin, which covers the bell-shaped elliptical aperture of a metal tube.

Duration an Elusive Speech Attribute

One of the most valuable uses of the kymograph is to aid one to decide the duration of speech sounds. There is no more elusive attribute of speech than duration. In music it is denoted by minims, crotchets, quavers, and so on. The name given to it by philologists, phoneticians, and writers on prosody is "quantity" or "length." A controversy about quantity was settled by recourse to a single experiment. The circumstance which led to the making of a record was as follows: There arose between Dr. Inge, Dean of St. Paul's Cathedral, London, and Dr. Robert Bridges, Poet Laureate, a discussion about the respective lengths of *a* in "cattle" and *a* in "cater." The Dean was invited to the phonetics laboratory at University College, London, to clinch the argument.

A glance at the tracings showed the equality in the vowel lengths of the so-called short and long *a's* in these words. Each *a* took eleven-hundredths of a second to pronounce; so that Dr. Inge's contention that the vowels were of equal length was fully established. Perhaps under the circumstances, it was but human that he should feel gratified.

Figure 1 shows a kymographic record of the word "tea" pronounced by an Englishman, while Figure 2 shows the same syllable pronounced by a Frenchman. The straight portion *ab* represents the closure of the mouth-cavity made by the tip of the tongue coming into contact with the teeth or the teeth-ridge; *bc* represents the explosion made at the instant when the contact of the tongue is released. The wavy line shows that the air is being set in vibration by the vocal cords and therefore denotes voice. It will be readily seen that whereas in Figure 1 the voice starts operating immediately after the explosion, in Figure 2 it does not. The portion *cd* shows that the vocal chords are kept apart for a little time allowing a current of air to issue from the lungs. This phenomenon is called "aspiration" and is characteristic of these explosive sounds in English, German and the Scandinavian languages.

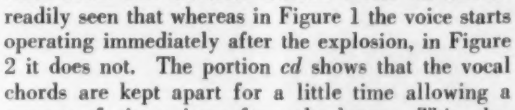
In the case of certain other languages matters would be very different. Some languages have both aspirated and unaspirated sounds of the *t* class, distinguishing one word from another; great confusion of meaning might arise if proper care were not exercised in putting in the aspiration where it should be present and leaving it out where it should be absent.

Valuable to the Study of Phonetics

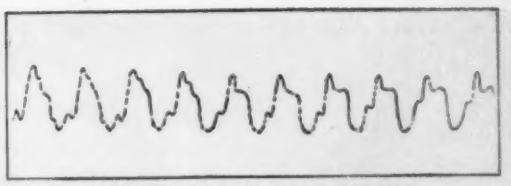
The importance of accurate attention to details of enunciation is amusingly illustrated in the following story, told by Lord Meston, one of the most distinguished of Indian administrators. It appears that a well-known general on one occasion decided to address his native troops on parade with a few words in the vernacular. His opening word was intended to mean "troopers"; but, to the amazement of all who understood, the barrack square reverberated instead to a word which meant "swine!" By means of the kymograph the distinction is made clear, as Figures 3 and 4 show. They show the extent of the downward movement of the jaw with a simultaneous voice record beneath (observe the movement when the *r* is articulated). Figure 3 represents the word "suaro" (troopers).

Because of the delicacy with which the kymograph registers the details of speech, its great value in the investigation of certain nervous diseases will be obvious. The utterance of such nervous cases shows characteristic features and from these important diagnoses can be made. This use of the kymograph is, however, outside the scope of the work done in the phonetics department of University College, London, which concerns itself mainly with the analysis of languages.

The importance of the phonetic kymograph in all researches into speech is becoming universally recognized. New languages for the purposes of commerce and human intercourse generally have to be analysed. These languages often possess unusual features which the unaided ear is unable at first to catch, with the result that the science of experimental phonetics is now accepted as not only useful but essential in linguistic studies. Moreover, with the universal popularity of radio, the spoken language is becoming more and more important, and pronunciation is tending to be considered synonymous with education and breeding. It is a significant fact that when writing "Pygmalion" and casting about for the most competent person to train a common cockney flower-girl to pass as a duchess, Bernard Shaw chose as her instructor a professor of phonetics.



SIR HARRY LAUDER'S VOICE
FIGURE 9: *Portion of a record of Sir Harry Lauder's voice as he sang "Oh, it's nice to get up in the morning." Magnified 350 times*



ANOTHER GRAMOPHONE RECORD
FIGURE 7: *A note of a cornet magnified 350 times*

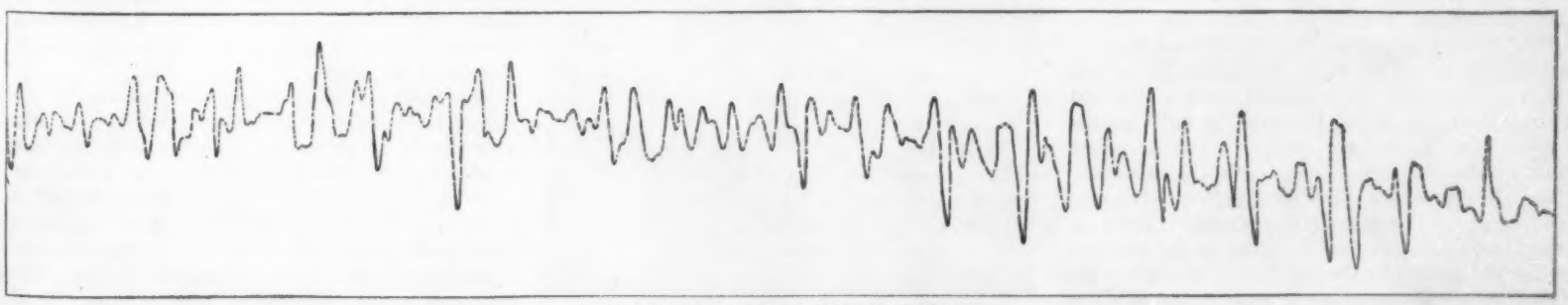
ENLARGEMENT OF THE VOWEL "A"
FIGURE 8: *The vowel "a" as in the French word "pate"*

To Analyze Phonograph Records

We now come to the second instrument shown on the opposite page. This machine was constructed for enlarging gramophone records. It is called the Lioretgraph from the name of its designer—Monsieur Henri Lioret of Paris. It is operated by turning the handle through a suitable arrangement of belts and pulleys. This causes the disc to rotate about a vertical axis as well as to travel horizontally; it also makes the drum (which has on it a band of smoked paper) rotate on the horizontal axis. All these movements occur simultaneously.

The process of enlarging is effected in the following manner. The gramophone needle is placed carefully in the groove of the record. As the handle is turned the needle follows the track of the record and the movements of the needle actuate a lever. Any motion is magnified twenty times. Means are provided for magnification from two hundred times upwards. The magnified tracings are recorded on a band of smoked paper on the drum.

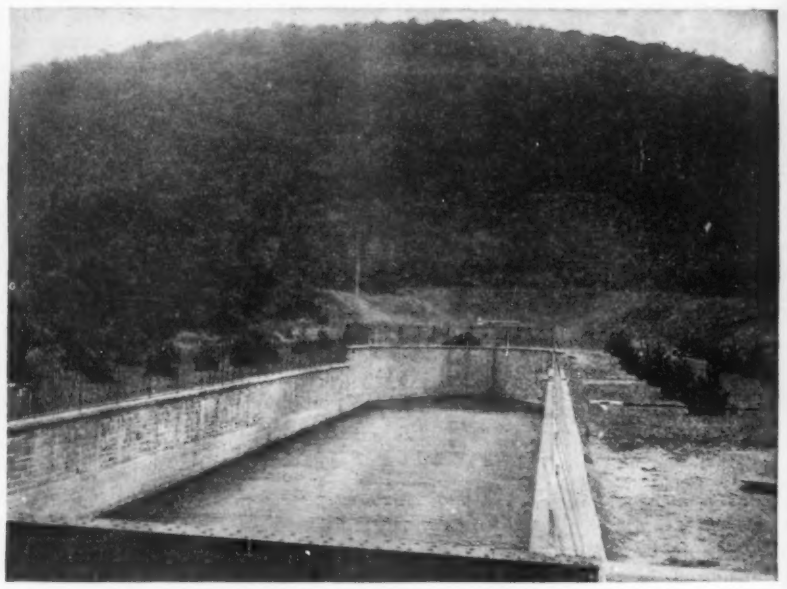
By means of a small mirror movements can be registered by a spot of light on a sensitised film. Photographic records of enormous magnification are obtained in this way. The other figures are examples of the results obtained by the use of these instruments.



ANALYSING A PHONOGRAPH RECORD
FIGURE 10: *That portion of a record of the overture "William Tell" which describes the storm. Played by the Queen's Hall orchestra, conducted by Sir Henry Wood*

DETERMINING FORM OF DAM BY MODELS

Models to three scales to determine best method of controlling flow over crest of dam



OUTLET OF SHANDAKEN TUNNEL TO ESOPUS VALLEY

After flowing for 18 miles through the mountain range Schoharie water enters Esopus Creek

Running a River Through a Mountain

Gilboa Dam and Shandaken Tunnel the Crowning Achievement in the Water Supply of New York City

By J. Bernard Walker

AMONG the notable feats of civil engineering in America we do not hesitate to place the water supply of New York City in the very front rank. It may be said that the great works in the Catskill and Schoharie watersheds, in their complexity, in the difficult problems involved, and in the great variety of the work that was done, stand pre-eminent among the city supply systems of the world. Although the present article is concerned specifically with the new Schoharie water supply, including Gilboa Dam and the 18-mile Shandaken Tunnel, it will be in place at the outset to give a brief survey of the great struggle of the past 75 years to secure an adequate supply of pure drinking water to match the phenomenal growth of New York City.

Work Free from Political Interference

The first effort to provide not merely for the present but for the probable future needs of the city was the development of the Croton watershed, begun in 1837, by building a series of dams of very moderate size on the Croton River and its tributaries. This project included an aqueduct from the reservoirs to New York, which is still in service. On its completion the city fathers believed that they had secured sufficient water for an indefinite period; but before many decades had passed, the ever-growing city was threatened with a possible water famine, and it was determined in 1892 to build a lofty dam on the Croton, not far from the Hudson River, and create a reservoir which should overtop the old Croton Dam and extend for some 20 miles up the valley. This great dam, some 300 feet in height from foundation to crest, attracted world-wide attention. It impounded 34 billion gallons of water, which was led through a larger aqueduct, aided by the old aqueduct, for some 31 miles, to the reservoir of the old system in Central Park. The above development is shown in the accompanying birdseye view on the easterly side of the Hudson River.

This great work was scarcely completed before Greater New York began once more to be anxious for the future; and as a preliminary to developing the waters of the Catskill Mountain region, there was appointed a Commission known as the Board of Water Supply which was to have full responsibility for the work. Most fortunately, this board was so constituted that it is free from political interference and its financial requirements are not hampered by any consideration of the city debt limit, since the water-supply systems of the city are on a self-supporting basis.

NEW YORK WATER SUPPLY AT A GLANCE

Birdseye view showing Gilboa, Ashokan and Croton reservoirs and the 120-mile aqueduct to New York City

The first development was that of the watershed of the Esopus stream which, with its tributaries, heads in the higher ranges of the Catskill Mountains. To this end was built the great Olive Bridge Dam across Esopus Creek, which consists of a main masonry structure, 252 feet from the lowest foundations to the crest, which, with the earthen dikes which close the gaps between the hills, has a total length of 5½ miles and serves to impound 128 billion gallons of water.

In addition to the Ashokan Dam there was built the Kensico Reservoir, in Westchester County, thirty miles north of City Hall, which was designed to provide sufficient Catskill water to supply New York over a period of several months. It is an emergency reservoir to serve the city should the aqueduct between Kensico and Ashokan be at any time out of service. This dam has a maximum height, from foundation to crest, of 307 feet; and the reservoir has a total available capacity of 29 billion gallons.

Eighteen-mile Tunnel Beneath City

Fifteen miles south of Kensico and just to the north of the New York City line, on the highest ground available in the city of Yonkers, is an uncovered artificial reservoir, contained by an earth embankment and lined with concrete, which has a depth of 36½ feet and holds 900 million gallons of water. Its function is to equalize the difference between the use of water in the city and the steady flow in the aqueduct.

The building of these extensive works by no means covered the whole of the problem; for this vast supply of water had to be got down to New York City. To this end a large aqueduct was constructed from Ashokan Dam to Staten Island, a distance of 120 miles. It varies from a horseshoe cross section 17 feet 6 inches by 17 feet to a circular diameter of from 16 feet 7 inches to 11 feet. The work was constructed entirely below ground, out of sight, and therefore protected from any possible contamination.

SHANDAKEN TUNNEL

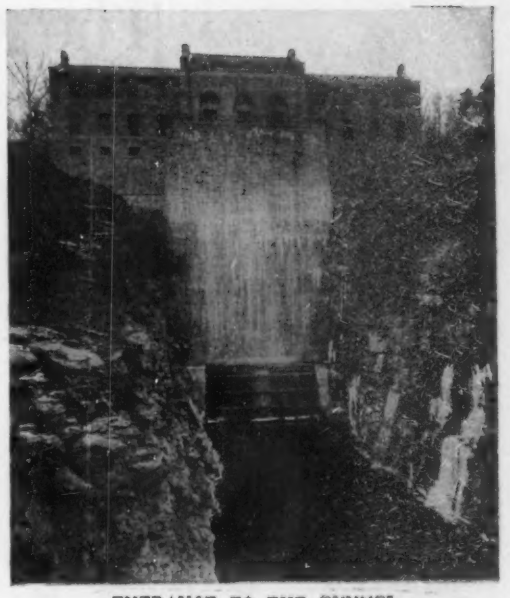
This great conduit, 18.1 miles long, was blasted through the mountain and finished off with a heavy concrete lining

Most remarkable of all are the syphon 1,200 feet below the Hudson and the tunnel beneath New York City. How many of its citizens realize that from Hill View Reservoir, just beyond the city line, a circular tunnel from 15 feet to 11 feet in internal diameter, has been driven in the solid rock for a distance of 18 miles, or nearly to the end of Manhattan Island, and thence under the East River to Brooklyn. Hundreds of feet below the roar and bustle of the city is this great artificial conduit, whose supply of pure mountain water is tapped at various places through vertical shafts extending to the surface.

The latest of these works for bringing pure mountain water into the city, if not the greatest in magnitude is certainly the most appealing in regard to its novelty and daring. In looking for some new area among the many watersheds of the Catskill Mountains, a most extensive survey was made both of the streams which flow into the Hudson River and of those which flow in a general northerly direction into the Mohawk River. Of the latter, the most promising was Schoharie Creek; but between the great Ashokan Dam which impounds the Esopus Creek and the Schoharie Creek there lies one of the loftiest ranges of the Catskill Mountains. And if a reservoir were formed by a dam across Schoharie, how would it be possible to bring this water to New York City? It could not be pumped over the mountains, for the cost would be prohibitive. So the engineers of the Water Commission decided upon a bold and unprecedented step. The flow line, or surface level of the water, of the Gilboa Dam is 1,130 feet above sea level, whereas the flow line of Ashokan is 590 feet above sea level. The bold step was taken of driving a tunnel entirely through the intervening range of mountains for a distance of 18.1 miles, and thereby passing the water into Esopus Creek down which it flows to the Ashokan Dam.

Gilboa Dam and Tunnel

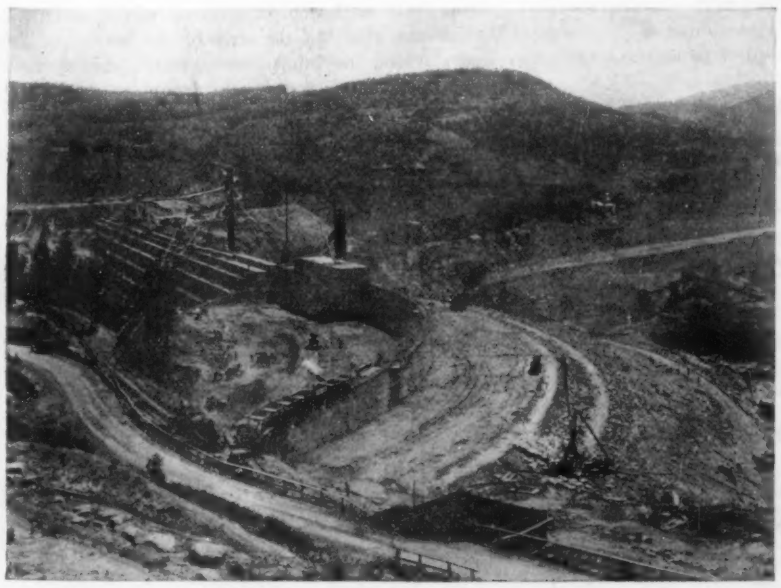
The Gilboa Dam, which is practically completed, consists of two parts, a masonry portion which is 1,300 feet in length, with a maximum height of 182 feet and a width of 158 feet at the base, and an earth section with a core-wall, which is about 700 feet long. The surplus waters in time of flood will be spilled over the top of the masonry dam; and at the toe of the dam there has been built a wide spillway which will receive these waters and pass them down into the Schoharie River bed. The upstream face of the dam is approximately vertical; but the downstream face has been formed in a series of eight steps, most of which are 20 feet in depth. The object of this was to let the enormous amount of storm waters, which at times will pass over the crest with a depth of five feet, down to the foot of the dam in a series of cascades, so as to diminish the force of the impact when they reach the bottom. If this water fell over in a continuous cascade, its energy would be sufficient to disintegrate the rock at the toe of the dam and endanger its stability. Mr. Thaddeus Merriman, chief engineer of the Board of Water Supply, with a view to breaking up the initial rush of the waters at the crest, is building on the crest a series of diagonal masonry vanes, which will cause the water to leave the edge of the dam in diagonal and opposed directions, thereby absorbing some of its energy and facilitating its passing in cascades down the 160 feet of fall. The masonry section of the dam is founded on solid rock. It was built of cyclopean masonry, consisting of very large blocks of stone buried in concrete. A 700-foot earth section was necessitated at the west bank because of an old and very deep underlying pre-glacial gorge. The core wall of the earth embankment, which is continuous with the masonry section, extends through the earth section and is carried deep into the hillsides and also a hundred feet below the natural bed of the valley, so as to intercept any underground water flow. The reservoir formed by the dam will extend nearly six miles up the valley and will provide an available supply of 20 billion gallons of water.



ENTRANCE TO THE TUNNEL

Above is the Gate House and below are the bronze locks through which Schoharie enters the Shandaken Tunnel

The Shandaken Tunnel is longer by 1,787 feet than the above-mentioned tunnel below Manhattan Island, which hitherto was the longest tunnel in the world. The northerly 3½ miles of the tunnel is depressed, making that portion a pressure tunnel; but along the rest of the distance there is a uniform slope of 4.4 feet to the mile toward the Esopus Valley. At the intake is a fine masonry building for housing the controls of the gates, which is shown in one of our illustrations. The water enters the tunnel through bronze gratings; and after its journey of over 18 miles, it issues from the side of the mountain into an open masonry-lined cut, through which it is led to Esopus Creek. To anyone who has been favored with a reasonable amount of sentiment and imagination, the sight of this river of crystal-clear water streaming forth from the base of the mountain is appealing. The total cost of the entire Catskill Mountain Water Supply System is $188,000,000.



GENERAL VIEW OF GILBOA DAM

This shows the masonry dam, 1,300 feet long, and in the foreground the earth dam section

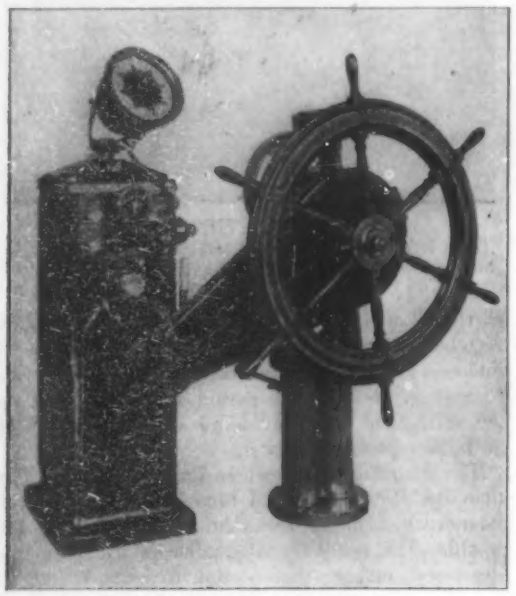
DOWNSTREAM VIEW OF GILBOA DAM

The downstream face is stepped to break the force of the overflow into the spillway below

The Automatic Quartermaster

The Gyroscope Automatically Guides the Ship, the Steersman Standing By

HAVE you ever heard of "Metal Mike?" He is a little iron man, who has invaded that nautical holy of holies, the pilot house, the home of the quartermaster, and taken his place. And the remarkable thing about this usurpation is that no one resents it; in fact, the quartermaster, who by all the rights of the case should be most disgruntled, is Metal Mike's best friend and greatest admirer.



THE SPERRY GYRO-PILOT

At left is a repeater compass, which through contacts operates a motor in the case below. This motor, through a chain drive, operates the steering wheel at right

Now Metal Mike is a seaman's nickname for one of the most ingenious and successful nautical devices ever designed since the first savage shaped a tree trunk into a canoe or flaked a stone for the head of his tomahawk.

Every one of us, doubtless, possessed at one time in his boyhood that curious little toy called the gyroscope, whose fantastic performances caused our eyes to open wide with all the incredible wonder of youth. "Just a toy," people called it in those days—yet today it is one of those boyhood toys that has laid its hand upon the steering wheel of the *Leviathan* and guides that mighty ship, unerringly, day and night, upon its course. The Sperry Gyro-Pilot is compass and quartermaster rolled into one. In the most literal sense, it has displaced the hand of the human pilot, as shown in the accompanying illustration. Once the course is set, the captain, first officer, seaman—either of them merely "stands by"; that little toy of your boyhood does the rest, and steers a straighter course than the most skilled quartermaster can accomplish. If you doubt it, look at the comparative record of hand steering and gyro steering as shown at the bottom of this page and note the even course steered by the gyro-pilot.

The gyro compass has taken the place of the magnetic compass because it is free from the defects of the latter. The magnetic compass does not point to the true north. In some locations it points to the east of north, in other places to the west of north. This is known as the variation of the compass. Its amount must be known at any given place, and an east or west correction applied before the navigator can determine the true north and lay his course with accuracy.

Always Points to True North

Now the gyro compass is subject to no such variation. Once it is adjusted to true north, to true north it will point throughout the voyage. This is due to the action of a law of motion which says: "Every body continues in its state of rest or of uniform motion in a straight line, unless it is compelled by forces to change that state." If a gyro, set in gimbals so as to have perfect freedom of angular movement, be set spinning at the equator, with its axis horizontal, its axis, as the gyro is carried round by the rotation of the earth, will not change its position with regard to space, but it will change its position with regard to the earth. By the time the earth has rotated through ninety degrees, the axis of the gyroscope will be perpendicular to the horizontal; and so it will appear to rotate (contra-clockwise) throughout the twenty-four hours of a complete rotation of the earth.

This action of the spinning gyro is shown in the right-hand diagram at the bottom of this page. It takes place in accordance with the law of motion above quoted and is known as "fixity of plane."

Another characteristic of the gyro is "precession." If you apply pressure to the frame of a spinning gyro, tending to tilt it in a certain direction, the axis of the gyro wheel will tilt, not in the direction of the pressure but at right angles to it—in other words, the gyro will precess. The phenomenon of precession is utilized in the gyro-pilot to secure constant north indication.

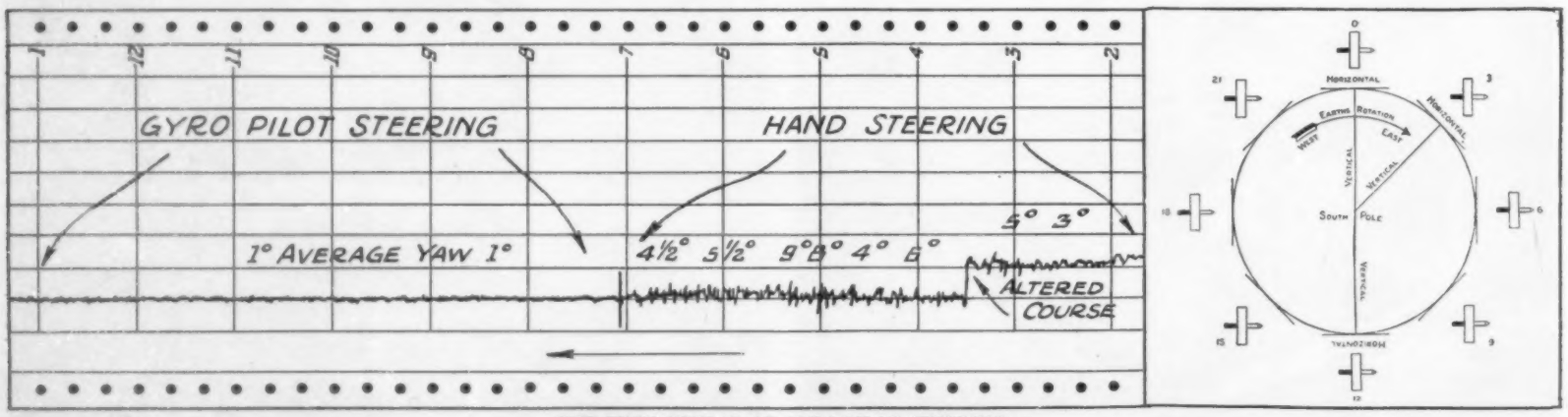
A U-tube, partially filled with mercury, is mounted perpendicularly to the plane of the gyro wheel and rigidly connected to the bottom of the gyro case. The flow of mercury to the low side of the tube as the earth rotates furnishes just the amount of force about the horizontal axis of the gyro wheel to make it precess to the meridian and continue to point exactly and all the time and at any and every spot on the face of the earth to true north.

The master compass contains a gyro wheel weighing 55 pounds, which is driven by an electric motor at 6,000 revolutions per minute. Repeater compasses may be placed throughout the ship. The compass, moreover, automatically records the ship's course and time on a strip of paper for the information of the officer in charge of the bridge.

The latest feat of the inventor, Mr. Sperry, after whom this compass is called, was to arrange for the compass automatically to steer the ship. This it does through a contact-maker operating a motor on the steering column. A chain drive leads from the motor shaft to the ship's steering wheel alongside. We invite a study of the strip at the bottom of this page showing the improvement in the ship's course when the change was made from hand to gyro steering.

INSIDE A LINER'S PILOT HOUSE

Here we see the gyro-pilot, or automatic quartermaster, coupled up and steering the ship. The quartermaster is no longer required, except to stand by in case of accident



THE EVEN COURSE OF GYRO-PILOT STEERING

LEFT: *The line in the left-hand portion of the diagram was automatically drawn by the compass itself. At the right, the jagged line shows the inequalities of hand steering.* RIGHT: *The gyro maintains the same plane with regard to space, but changes its plane with regard to the earth*

From the Oldest City in the World

The Ruins of Ur, Traditional Birthplace of Abraham, Yield New Art Treasures

Photographs by courtesy of the British Museum, London, through the Illustrated London News

THE eleventh chapter of Genesis tells us how Abraham and his kindred left their ancestral home in "Ur of the Chaldees" for a journey which was to end in the land of Canaan. For over two thousand years that was all that the world remembered of the once great city of Ur, possibly the first great city to be built in the world.

Such Babylonian histories and traditions as had come down to modern times through the great Greek historian Herodotus or the ancient Babylonian priest Berosus, did not mention Ur. The "Chaldeans" were remembered through references to their remarkable knowledge of "magic," by which was meant, of course, the science of ancient times. But their city was forgotten except for that one brief mention in the story of Abraham.

About a half century ago it was rediscovered. A huge mound of dirt, rain-washed and featureless,

One of the copper bulls from the remarkable relief found at Tell el Obeid, near the site of ancient Ur. The head was cast, the body hammered out of thin copper plates and attached to the head with nails

was known to be standing in the desert just west of the channel of the Euphrates River and about one hundred miles up stream from the present shore of the Persian Gulf. Some bricks inscribed with the curious wedge-shaped writing of ancient Babylonia were found near this mound. When these inscriptions were translated they proved that the great mound and some smaller ones surrounding it are all that is left of the city where Abraham was born.

Little work was done on this mound until after the World War. The conquest of Babylonia by the British armies then opened up the country for archeologists. During the past three years Major C. L. Woolley, commanding a joint expedition of the British Museum and the Museum of the University of Pennsylvania, has been making extensive excavations in the mounds that mark the ancient city.

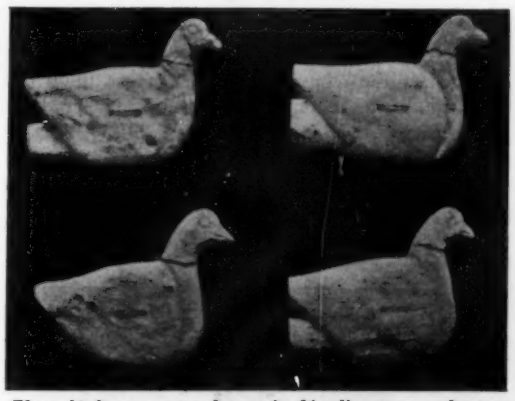
Not only has Major Woolley discovered great temples and other buildings which belonged approximately to the time of Abraham, some four thousand years ago, but he has carried the history of the city many centuries farther back. When Abraham was a boy in the house of his kinsmen of Ur thirty-five or forty centuries ago, the city was already more than two thousand years old. It had already been a great seat of civilization and commerce for a period much longer than the time from the birth of Christ to the present day.

The oldest written inscription ever found in the world turned up not far from Ur, at a place now called Tell el Obeid, probably one of the suburbs of ancient Ur. This inscription had been placed originally in the foundations of a temple, just as we still place boxes containing newspapers and other mementos in the cornerstones of modern buildings. The inscription is carved on a small tablet of stone in the curious picture writing which was then in use at Ur. Scholars of the University of Pennsylvania have translated it. It says that King A-an-ni-pad-da, who ruled Ur in those days, dedicated that temple to the Goddess Nin-har-sag. It was written, the experts believe, about the year 4500 B.C., more than sixty-four centuries ago.

The excavations have yielded, also, many remarkable art objects, some of which are illustrated on this page. The walls and courts of the great temple of Nin-har-sag, as well as of other public buildings, were decorated with painted or sculptured scenes.

Among the treasures found at Ur is a wonderful relief showing a procession of bulls and made out of cast and hammered copper. Other objects are made of bits of white shell inlaid on a ground of black bitumen. This bitumen is our modern "crude oil" or asphalt. It was collected at the oil springs and seepages which still exist in Babylonia. It served the masons of Ur as mortar and the artists of the time as a cement to stick their reliefs and carved plaques to the walls.

The people who founded Ur were the famous Sumerians, a people who must have been one of the ablest and greatest of all history, but who were totally forgotten until modern scholars began to dig up and read the records which had been buried for



These birds were carved out of white limestone and were probably attached, with staples, to the frieze which originally decorated the temple wall. They were found in the ruins of the temple of Nin-har-sag, at Tell el Obeid

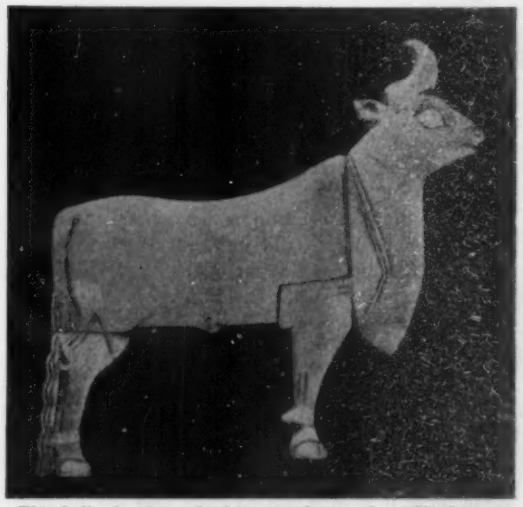
so many centuries in the ruins of the Babylonian cities. No one knows for certain where the Sumerians came from. The most plausible theory is that they came from India; possibly by overland migration but more probably in small boats along the shore of the Indian Ocean and the Persian Gulf.

Some time in the millennium between 5000 B.C. and 4000 B.C., these Sumerian immigrants arrived in what is now Babylonia. The country was inhabited then by rude tribes who eked out an uncertain existence on the low and tiny islands scattered among the marshes at the head of the Gulf. The Sumerians introduced civilization. They already knew how to write and make records. They possessed tools of copper. They wore clothes. Presumably they had tamed some animals, including a variety of buffalo. They had kings and wise men (who were also priests) and some ideas of religion.

By 4500 B.C., possibly by two or three centuries earlier, there were at least five great cities in the lowlands near the Euphrates River. One of these was Ur. The head of the Gulf was farther north then than now, and Ur was on the seacoast. Silt deposited by the two rivers is responsible for the hundred miles of land that now separate its site from the shore. Another great city was Eridu, a few miles further down the shore from Ur. Farther east, also near the then coast line, was another city named Lagash. Up the Euphrates some thirty miles was Erech and on an arm of the river was the fifth city, Larsa. These five made up the earliest Sumerian state, the first civilized country in the world.

This statuette, also found at Ur, is of much later date than the other objects pictured on this page. It is believed to belong to a time when Ur was under the rule of kings of other cities, about 2800 B. C.

In the twenty-five centuries that elapsed from those days to the time of Abraham, Sumeria suffered many vicissitudes. Kings and dynasties came and went. A semitic people from the hill country



This bull, also from the frieze in the temple of Nin-har-sag at Tell el Obeid, was carved in white shell, probably taken from the Persian Gulf

to the north and west came down and conquered the five cities. They absorbed the writing, the arts, the civilization of their victims. Wealth and prosperity grew. Other cities were founded, including the great Babylon, a hundred miles farther up the Euphrates. Finally, in Abraham's time, the twenty or more cities then existing on the Babylonian plains had become the commercial and artistic centers of the world.

Brown Brothers

Wintering Habits of Insects

By S. F. Aaron

Drawings by the Author

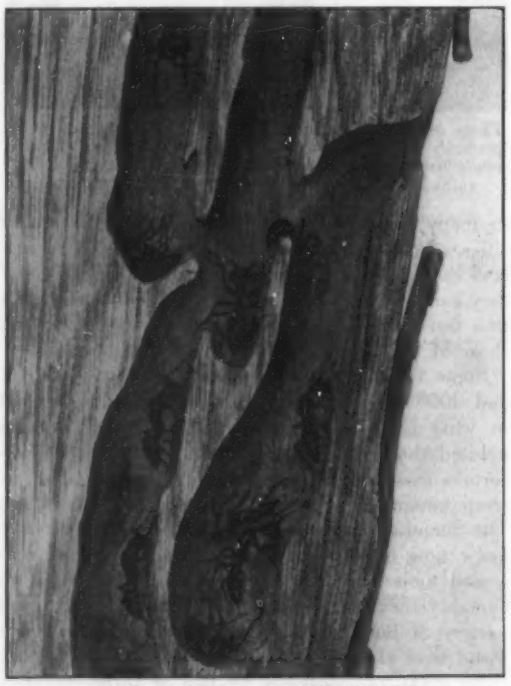
ALTHOUGH summer time and hot weather is the season wherein the entomologist can find the most abundant opportunity for investigation of the habits and the struggle for existence among the insect hosts, there are also during the other seasons—even in the winter—periods permitting of and inviting delightful inquiry.

An understanding of the general aspect of this subject must include the knowledge that suspended animation is the rule among nearly all so-called cold-blooded animals, whether having indoskeletons or exoskeletons, (vertebrates or invertebrates as commonly understood). Despite the asseverations of would-be interpreters of nature that cold destroys all life, or at least all life not especially protected, it must be here insisted upon that among all of the lower animal forms, cold in itself destroys no life that still has its normal functions to perform, although it may somewhat hasten death.

Shelter from Enemies Important

Thus, ants, butterflies, bees live their lives within a few weeks' time and, suddenly becoming decrepit, die in any season. Cold or excessive dampness hastens this demise. But if the creature's natural functions in propagating its species have not been performed, if it still has to mate and lay its eggs, it will not die under normal conditions of cold, no matter how severe. The crushing effects of ice may prove fatal; hence the hereditary instinct of insects to seek places of shelter for the placing of fragile eggs and cocoons, the hiding away of adults or pupae in dry crannies and crevices. Even more important than shelter from the weather is that from enemies: the close-gleaning winter birds, the mice, shrews and squirrels and certain larger quadrupeds, as the skunk, opossum, raccoon and even the bear.

Many insects and others of the Arthropods commonly pass the winter in the egg stage; these are the *Orthoptera* generally, (grasshoppers, crickets, wood roaches, walking-sticks and mantis), most of the true bugs *(Hemiptera)* and the spring-tails *(Thysanura)*—all insects with active pupae. Spiders, pedipalpi (daddylonglegs), and the millipeds survive the season of cold both as eggs and as young, protected by webs and by hiding.



HOW BLACK ANTS HIBERNATE

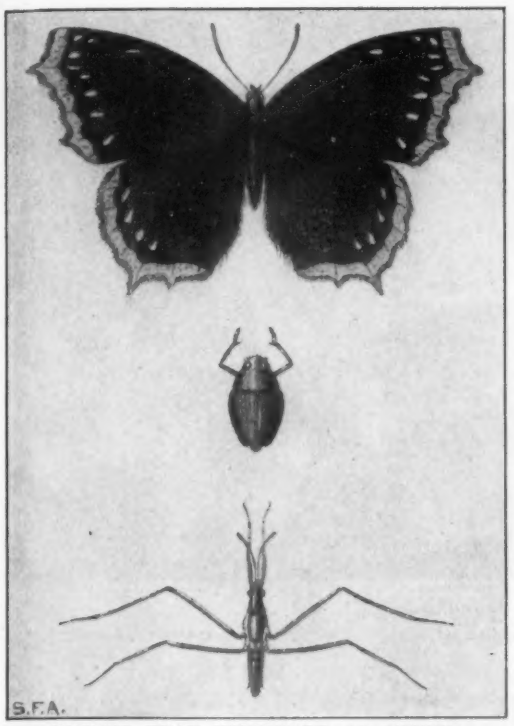
These insects winter in old beetle borings which they often enlarge for nests. If the long tongues of woodpeckers do not reach them, many will survive the cold. Wood split to disclose borings

Most other insects that go through imperfect metamorphoses, such as the several varied waterflies *(Neuroptera* and *Perla)*, the dragonflies *(Odonata)*, and the caddisflies *(Trycoptera)*, pass their transformations in the water and mostly winter as larvae and pupae, although sometimes as eggs attached to water grass or under stones, sticks and leaves in shallow places either stagnant or moving. Other allied forms, such as the ant lion, *panorpa* and *mantispa*, lay their eggs in loose earth where, if laid late in the season, they remain to be hatched by the spring sun, or, if earlier, the larvae remain in the same spots. Allied barkflies *(Psocidae)*, protect their eggs by webs or by depositing them in the tiniest chinks and cracks.

Some Migrate to Warmer Climes

Those insects with inactive pupae and that pass through, therefore, complete metamorphoses, such as the butterflies and moths *(Lepidoptera)*, the bees and wasps *(Hymenoptera)*, the beetles *(Coleoptera)*, and the two-winged flies *(Diptera)*, almost invariably survive the winter in the pupae or chrysalis form, or as adults, far more rarely as eggs or larvae. Any instance of the latter may be explained by the fact that the adults are hatched late and consequently that they are late in laying their eggs. We may observe certain butterflies, as, for example, the common sulphur yellow *(Colias)*, and the small yellow-spotted black swallowtail *(Asterias)*, ovipositing, the one on clover, the other on wild carrot, as late as October. These eggs hatch in spring; if hatched a little earlier the caterpillars may in a few cases survive the winter. All pupae withstand the cold; many revive early.

We see also black hornets, yellow-jackets and paper-nest wasps working as late as early October, seeking food and supplying their young. The larvae and even some late eggs are almost always sacrificed



INSECTS THAT HIBERNATE AS ADULTS

The mourning-cloak butterfly. A water beetle—the gyrating apple bug. A common water strider

to birds or shrews and some to fungous diseases. All of these species usually winter as adults, deserting their nests for narrow spaces and close pockets under loosened bark and for rock crannies where the larger number of them are found and eaten, despite their easily revived stings. Longfellow's well-known line might be most truthfully altered to read: "There are no hornets in last year's nest."

Bumblebees remain in their nests. These nests are generally well protected and warm from numbers, but many die from fungous diseases. Those that live seem to be mostly queens, some of which continue the same colony efforts in the spring, along with a few surviving workers.

There are a few species of all orders that winter as adults and even those that do are rarely in large numbers. Ants and honey-bees are an exception. Many flies perish, some *Tachinids* seek the paper nests of hornets deserted by the makers, or get into bark crannies and among piles of leaves where the winter birds find most of them. Mosquitoes and other gnats seek rock caverns, hollow logs and trees and man-made cellars where they often winter in considerable numbers.

Among the butterflies, the cosmopolitan mourning-cloak *(Vanessa antiopa)*, the angle-wings *(Grapta)*, and occasionally a Hunter's butterfly *(Pyramens)*, winter as adults. Some of the angle-wings and other species even migrate to more charitable climes to put in the winter and choose their places of hiding with the utmost care, wedging themselves into crannies hardly wider than will admit their folded wings.

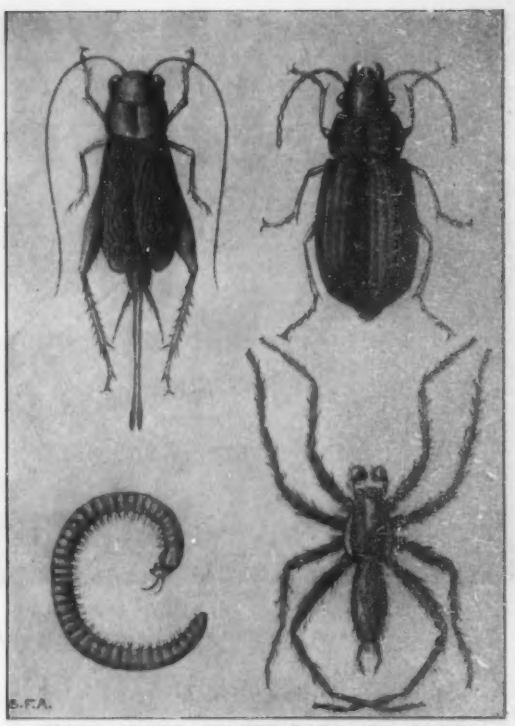
All Easily Revived by Warmth

Certain moths also may be found hibernating in dense clumps of grass and these are invariably seen early in the spring flying about thicketed fields. Moreover, as is the case with the butterflies above mentioned and especially the antiopa, sunshiny winter days often bring them forth and with wasps and bumblebees they may be seen flying about even over patches of thawing snow, while gnats and midges dance in the weak sunshine.

Certain beetles also, as the black ground hunters *(Harpalus)*, and members of the *Staphylinidae* pass the winter as adults; on mild days the dense leaf carpets under the snow may be scraped away and these little fellows may be seen scurrying away from the disturbance. The common brown elater beetle is another species that seeks flimsy winter quarters and is easily revived. Aquatic species winter in silt and among water grass roots.

A few of the insects that commonly experience a tragic ending of their days and a lack of resistance to enemies, with the coming of the enervating frost, sometimes successfully evade the hungry insectivorous hosts and may reappear in the early spring.

Some common short-horned grasshopper also awakes from deep sleep within the tangled stalks of a grass tuft where it has by chance escaped the shrews and mice. And the giant dragonfly *(Aeschna)*, is among the first to skim about in the earliest days of spring. Its transformations within the ponds are too slow to permit of its sudden appearance this early; the adult specimens must have survived the cold, but where they hide is a mystery. Gnats and other slender-bodied creatures can creep in anywhere, but the normal habit of these large dragonflies—their bodies and the expanse of their rarely

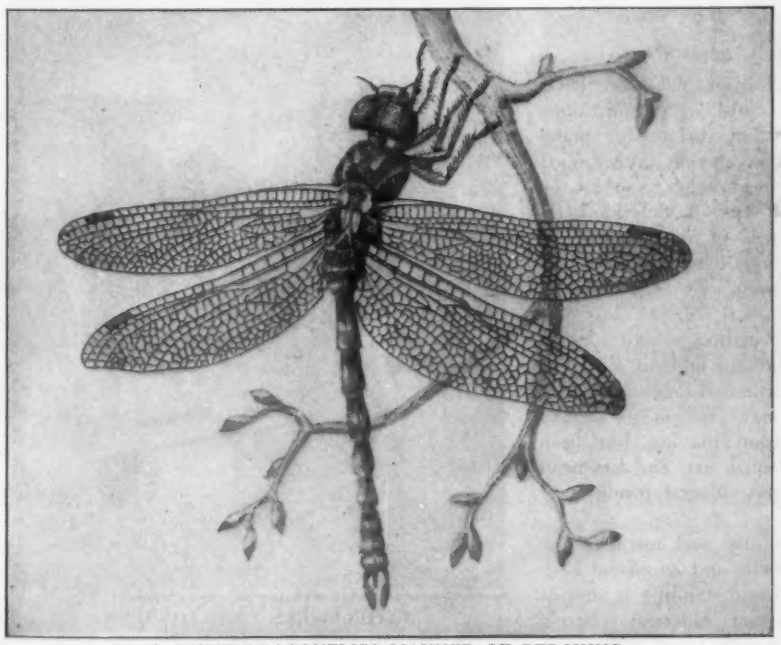


FOUND UNDER STONES, LOGS AND ROOTS

Female of the common cricket. A yellow-legged black ground beetle. A millapede. A funnel web spider

folded wings exceeding four inches—is to hang openly on an outer leaf branch where, when rendered comatose by the cold, they would be a ready tidbit for the birds.

To be more fully satisfied with regard to suspended animation—although the instances in nature are sufficiently conclusive—I have subjected many live insects, taken into the warmth during the autumn, to the most severe cold, often artificially induced. These specimens were exposed out of doors with the temperature at zero, encased in salted snow and ice, and frozen for many days. Some were placed in water so as to be enclosed by the forming ice. All these tests seemed to be convincing. In every case the majority of the specimens revived quickly—butterflies, moths, wasps, dragonflies, grasshoppers, roaches, beetles and colonies of bees and ants. Among the latter about two-thirds of the number revived; the others had reached their natural span of life.

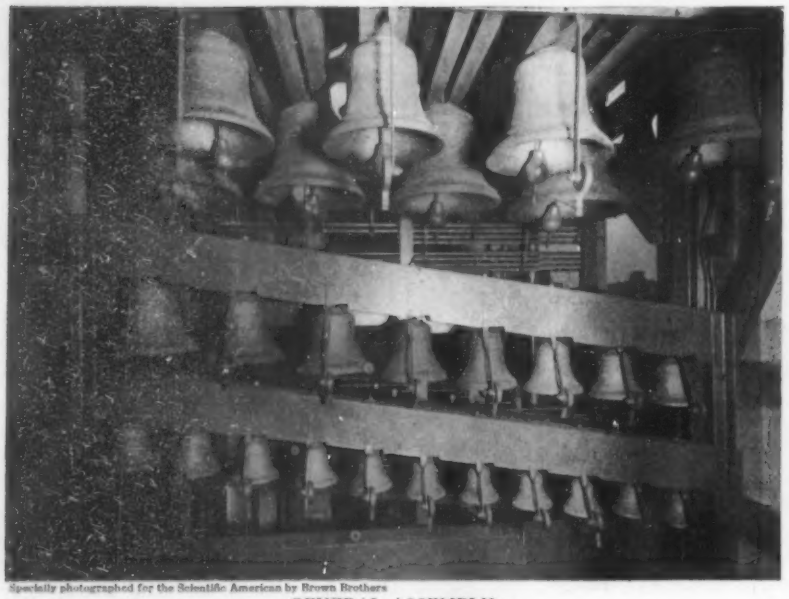


A GIANT DRAGONFLY'S MANNER OF PERCHING

It is a mystery how these insects escape their winter enemies. How and where do they hide?

RED-LEGGED GRASSHOPPER HIDING FOR THE WINTER

Here, within a grass clump, the winter birds, shrews or mice may find and eat it



Specially photographed for the Scientific American by Brown Brothers

GENERAL ASSEMBLY

The bells are hung on a rigid framework, thus permitting a close adjustment of the clappers

Specially photographed for the Scientific American by Brown Brothers

RINGING MECHANISM

A recoil spring insures tension and balance throughout the operating leverage

The Music of the Skies

How Bells, Which Had Their Origin in China Thousands of Years Ago, Have Been Developed Into Carillons and Have Been Brought to America

By Henry B. Curry

AMERICA is now enjoying the music of the largest and best of all the carillons. But what is a carillon? The carillon, still unfamiliar to many Americans, is similar to the bell chime, but far superior. It is the most lasting yet the rarest, the loudest yet the most ethereal, among artistic instruments.

Often we confuse the carillon with the chime. A set of chimes usually includes eight to ten bells, all fairly large, ranging in weight from 300 to 6,000 pounds. A chime is attuned only to the diatonic scale, that is, the white keys of a piano. Its range is very limited, although six bells suffice for playing "Lead, Kindly Light," and eight are enough for a hundred tunes. A first-class carillon will comprise from thirty to forty or more bells; great bass *kolokols*, to use the sounding Russian word, that may weigh 16,000 pounds, and little, silvery tinklers of twenty pounds or less. The range will be three or four chromatic octaves, including all the sharps and flats of the scale.

Real carillons are divided distinctly into two classes: mechanical instruments, wherein the bells are sounded through connections with an automatic revolving drum, after the fashion of a music box; and the far more artistic carillon, operated through a keyboard—more properly a handle-and-pedal-board—which is played, like that of an organ, by hand and foot.

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TOWER OF THE ANTWERP CATHEDRAL

Here the Hemony bells, the most famous of all carillons, are rung by the "master" bell ringer, Gust Brees, father and teacher of Anton Brees

Tuned as Accurately as a Piano

The invention of bells is claimed for China. Their association with pagan rites of old Greece and Rome, deferred their use in Christian shrines for many years. By the Ninth Century men with hammers were striking rude chimes in churches, and by the Sixteenth Century, when groups of Belgian bells were sounded first as adjuncts to town clocks, the carillon was started. The name itself has been connected with the "quadrillionen," or four diatonic bells, that composed a mediaeval chime.

From this beginning the carillon spread rapidly throughout Belgium and Holland and, to some extent, into Germany and Northern France. But for reasons that psychologists may discover its growth has been restricted. Carillon playing has been specially identified as a Flemish art, and has been accepted as "one of the finest cultural products of the Low Countries."

At present nearly every city and town in the "Nether" countries has its bells and its official bell-master or "carillonneur," whose standing is that of the organist in any important American church. About 100 carillons were recently listed in Belgium and, in Holland, 115. Nine of the Belgian carillons were destroyed during the war, but only two of these were important—that in St. Peter's at Louvain, and that of the famous Cloth Hall at Ypres. But those at Mechlin, Antwerp, Bruges, Ghent—the greatest quartet in the sky—have even been improved and are now more clearly perfect than ever before. France laid claim to forty carillons a dozen years ago, Germany to twenty. Only a score were left to other nations, including the English and Scotch sets and those in Ireland.

Although most Belgians have their favorites among the "Big Four" carillons that rejoice their nation, foreign comment inclines to favor the ven-

Specially photographed for the Scientific American by Brown Brothers

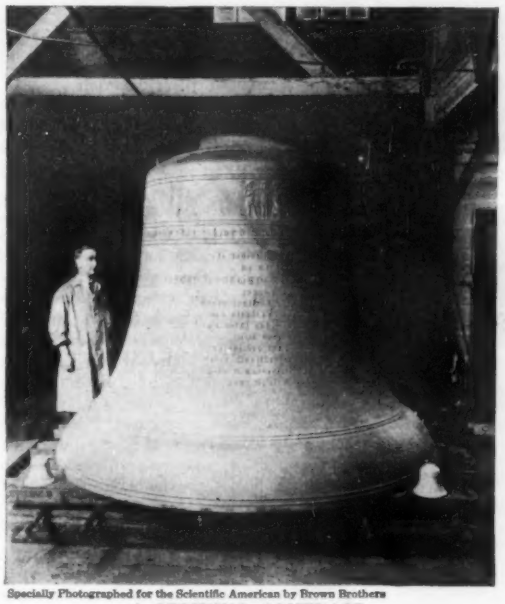
ANTON BREES, CARILLONNEUR

of the Park Avenue Baptist Church. Note the method of striking a chord. Three bells are rung on the keyboard and two on the pedals

erable instrument in St. Rombold's Tower at Mechlin; the more so that the master of these bells is Josef—or, as Belgium says, "our Jef"—Denyn, greatest of living carillonneurs.

Adequate expression of tone can be gained only when the handles and pedals of a carillon keyboard, or *clavier*, are directly connected with the clappers of the bells. But it is only recently that it has been possible to arrange these connections in such a manner that the playing of a carillon would not overcome with exhaustion the performers at this most arduous of musical instruments. Happily most of the chief Belgian sets now have both a keyboard for artistic recitals and also a mechanical connection with the town clock.

The lesser carillons may be altogether mechanical.



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A STRIKING CONTRAST

The small 12-pound bell and the big 9-ton "toller"

Hence one hears the carillon playing in Belgium or Holland at stated hours on Sunday, on market days, at festivals, and so on. Jef Denyn thus welcomed President Wilson with "The Star-Spangled Banner" when he visited Cardinal Mercier. But it is automatic playing that is heard four times an hour, and sometimes twice as often, from the belfries of each town. National melodies, operatic airs, hymns or folk songs are constantly repeated in a familiar order, although the program, which is always composed of really fine music, is changed several times each year.

A carillon bell is tuned quite as accurately, and far more permanently, than the best of pianos. The pitch or note goes higher as the diameter of the bell decreases; the volume or loudness falls off as the bell loses size and weight. How Franz and Pieter Hemony, greatest of Belgian founders, tuned their bells in the Seventeenth Century is not known; but in the modern process 1,500 tuning forks are used. Gillett and Johnston, English founders who produced the equipment which has recently been installed in the Park Avenue Baptist Church, New York, by John D. Rockefeller, Jr., in memory of his mother, have rediscovered, it is said, the secret of the mellow richness, the wondrous individual harmony, so long restricted to the Hemony bells.

By means of a recent improvement to the console (that is, the striking apparatus, keyboard included), the same makers have removed a serious physical obstacle to the cultivation of carillon art. By hanging the larger clappers near the inner side of the bells, and by using a clever system of counterbalances, the keyboard touch has been so lightened that the writer was enabled to strike with his little finger a cannon-boom upon the nine-ton bass of the instrument in the tower of the New York church.

Although this carillon is quite the largest, comprising no less than fifty-three bells—four octaves and a half—the three or four octaves of accurate, musical, chromatic notes in each of the big sets permits the interpretation of an inexhaustible variety of the world's best music. It must, of course, be music appropriate for such a medium—but every instrument presents a like demand. The range of the new American bells is from E below the bass clef to second A above the treble.

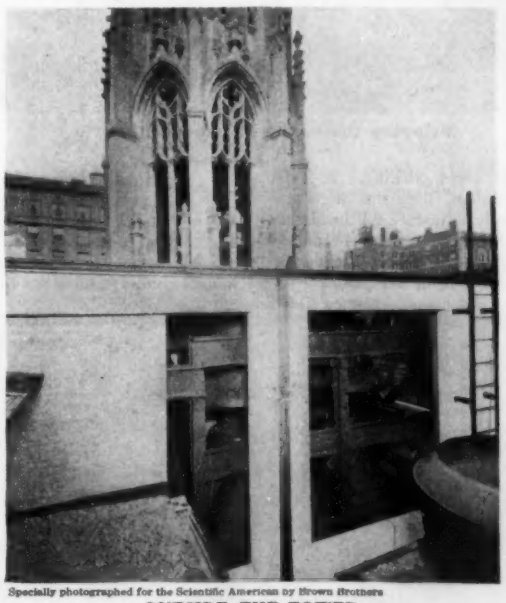
In the recitals or special concerts, such as those three times a week at Mechlin—

> 'Saturday for country folk
> And Monday for the city;
> Sunday for girls who charm the men
> And make themselves so pretty."—

difficult music is not uncommon. Bach's intricate "Fifth Prelude," for example, was the special rendition at a notable competition of bell masters held at Mechlin in 1910. But a typical program was that presented by Jef Denyn, four years later, on the exquisite Hemony bells of the Antwerp Cathedral. This program included Verdi's "Jerusalem"; "Lob der Thranen" from "Rosamunde"; Schubert's "Fruhlingsglaube"; Nicolai's "Third Sonata," and works by Jef van Hoof, John Diedrich and Peter Benoit.

Rockefeller Gift a Masterpiece

Because of the special conditions inherent in bell music the most effective compositions for the carillon have been written by distinguished carillonneurs, and especially by their acknowledged chief, Matthias van den Gheyn, bell master of Louvain in the Eighteenth Century. Among fifty of his extant works, the "Fugues," not inferior to those of Bach and Handel, are full of plaintive melody, and are marked by strange effects that only skilled bell masters can fittingly interpret—such as the long pedal note, lasting three or four bars, in harmony with a running treble. Some such ethereal music must have awakened Victor Hugo when he wrote upon a window



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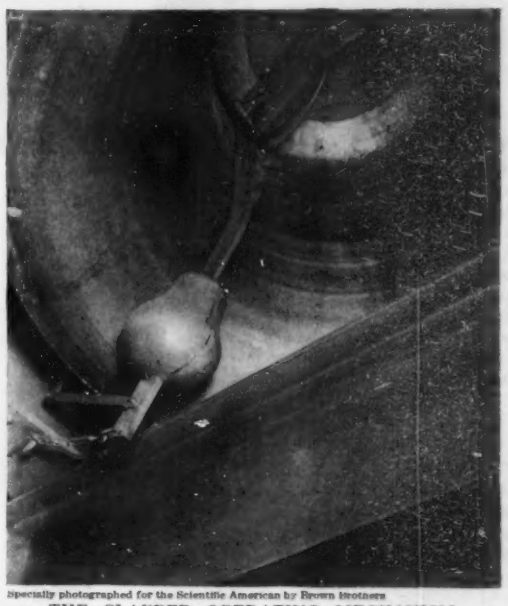
OUTSIDE THE TOWER

The big bells are housed on the roof of the church

pane in Mechlin his dainty verses about a Carillon Spirit descending from the skies upon a crystal stairway and scattering from her silver raiment magic notes upon the world.

All these fascinations of an unfamiliar art may yet delight America because of Mr. Rockefeller's gift. In addition to a carillon never surpassed nor even equalled, he has supplied the permanent services of an eminent Belgian carillonneur, M. Anton Brees, the son, and, until recently, the assistant, of M. Gust Brees, who as bell master of Antwerp and organist of the Cathedral, has upheld the classic traditions of his predecessor, J. F. Volckerick. First of the leading carillonneurs to visit the United States, Anton Brees gave recitals last year upon most of the carillons that have been multiplying in this country since 1922, the time that the New York bells were ordered. These instruments may now be found in many cities. The first, and for many years the only, carillon in the United States was that imported from France in 1870 by Saint Joseph's Cathedral at Buffalo, New York. Until lovers of all these bells heard Mr. Brees' dexterity, they did not realize what treasures they possessed.



Specially photographed for the Scientific American by Brown Brothers

THE CLAPPER OPERATING MECHANISM

A close-up view of one of the huge bells

Canada has several carillons, and Ottawa will equip its Parliament buildings with a duplicate of the Rockefeller bells, which have become a model for the world.

Concerning his $60,000 instrument, Mr. Brees says that he can only support the unanimous testimony of leading masters who tested the new carillon when it was set up temporarily at Croyden—that it had never yet been equalled.

The installation at the Park Avenue tower, however, is only temporary, awaiting the facilities of a new church at Riverside Drive and 122d street. Incidentally, it was at this corner that a national carillon, "The Bells of History," was to be erected in accordance with plans announced by artists and others three years ago. A "Peace Tower" carillon in Washington was another national tribute which has been previously discussed, but which has not yet materialized.

Eight of the bass bells, the largest weighing 19,000 pounds, are now walled in on the roof of the Park Avenue church; the forty-five small bells, including an angel-voiced "baby" that weighs twelve pounds, are suspended in the relatively low tower. Shut in by high buildings on several sides, the splendid carillon is well-nigh smothered; its song is scarcely audible six blocks away.

Bell Master Brees, accustomed to his ancient instrument, 300 feet above the market place at Antwerp, accepts Jef Denyn's dictum that 300 to 400 feet above the street is the necessary level at which to dominate a city and broadcast the carillon message for miles in all directions. To hear this message best, William Gorham Rice, the carillon Blackstone, recommends a station 500 feet from the bells and in full view of the belfry.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins

A self-adjusting jaw wrench

A Pair of Useful Wrenches

NOTHING is more useful around the home, the farm or the automobile than a good wrench. The two wrenches illustrated on this page are alike in general construction except that the one above has a self-adjusting jaw, adapting it particularly to work on bars or pipe. The one on the right is a "plier wrench" and is adjustable. It can replace a complete set of solid wrenches within the range of action of the jaws. It grips equally well across the points or on the flats of square or hexagon nuts.

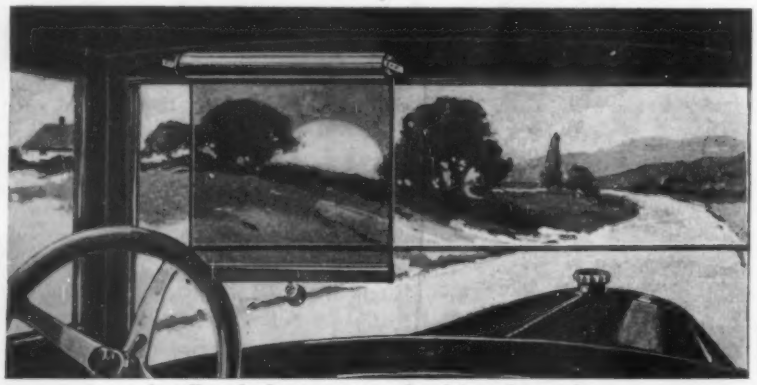
A Roller Shade for the Automobile

THE device illustrated is a new all-year-round protection for the eyes. It shields against the glare of the sun, bright lights, and winter's bright snows. It is made of green celluloid and is fastened to a wooden roller on which the transparent shade rolls up. Cloth strips are sewed on both sides and ends. These strips prevent the shade from coming in contact with itself, when rolled, and therefore preserve its cleanliness. It is operated and installed in the same way as is a window shade.

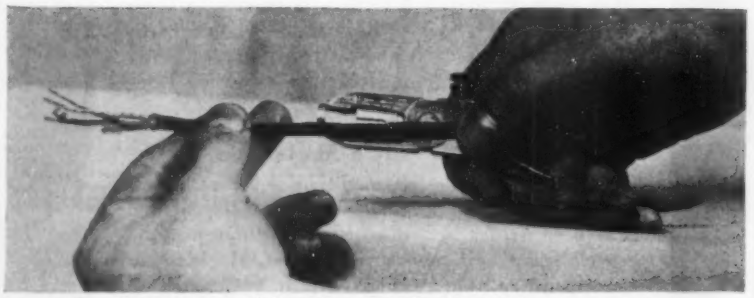
A Cord and Wire Stripper

SOME of the wire strippers we have seen are very clumsy and expensive. The device shown can be easily carried in the pocket. It cuts, strips and burnishes electric cord and wire without the use of a knife, and also replaces cutting pliers. It strips double or reinforced cord as well as single. It is adjustable for use in cutting and stripping all commonly used cords and wire, making a clean shear-cut, leaving no ragged edges on the insulation. The cord stripping is done with one motion. The directions read: "Adjust the cutters carefully, cut the insulation and pull." It is not necessary to twist the cutter. It is equipped on the side with a powerful set of shears and thus does the work of common cutting pliers. To strip double or reinforced cord, the outside covering is first severed with the knife projecting from the end of the side cutting blade as shown in the illustration. Then the two cords are separated and the stripping proceeds. To strip solid wire the cutters are adjusted so that they are a trifle larger than the wire.

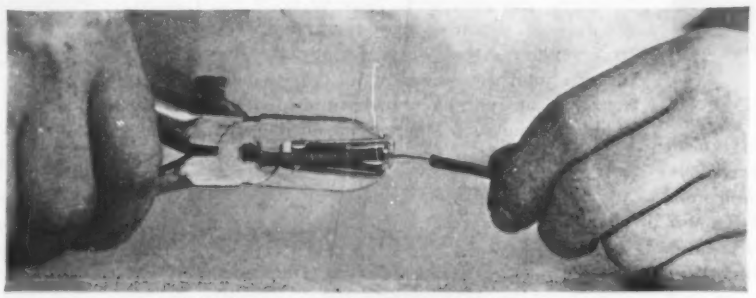
A paper seal for pies



A roller shade to protect the driver from glare



A safety device which replaces the knife for slitting coverings

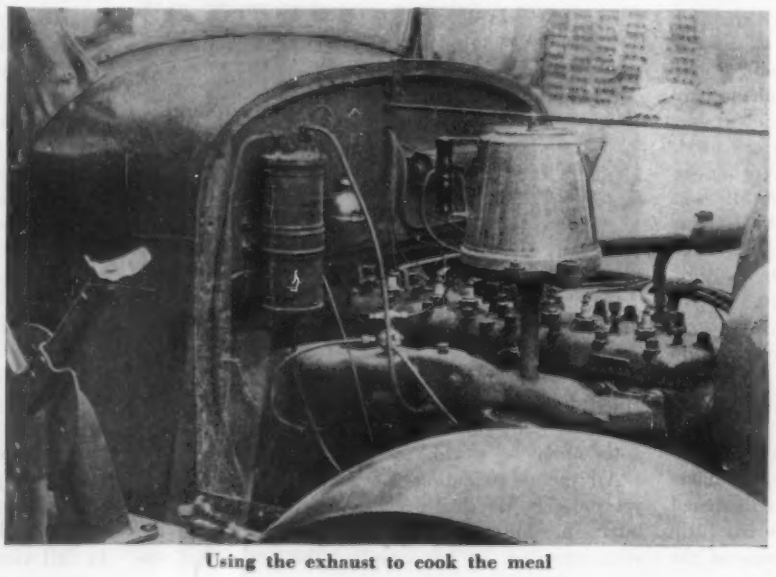


Stripping the cord with an ingenious tool

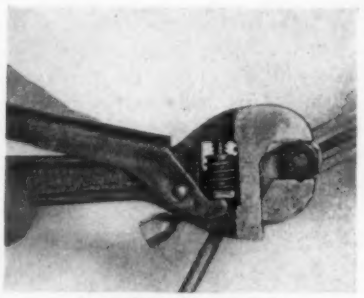
This is done to avoid nicking. A twist cuts all the insulation, then the pliers are pulled. If carefully adjusted, the insulation can be removed and the wire burnished with one operation. The wire should be burnished with the side of the jaw.

Seals Juice in Pie

AN enterprising housekeeper has found a new use for paper tape. It is wrapped around the edge of pies to keep the juice in! It is moistened slightly before it is wound around; and since the paper shrinks as it dries, it pulls the edges of the pie tightly together. It is easily removed after baking.



Using the exhaust to cook the meal



A useful plier wrench

Cooking by Exhaust

A MECHANIC of Columbus, Ohio, has invented a device by which motorists may now utilize the exhaust from their motors to cook their camp suppers. The contrivance uses a small petcock to close the exhaust pipe. A pipe connection is fitted to the exhaust manifold and joins with a round circular burner. This burner is provided with circular ribs, to prevent exhaust flames from jumping. Similar ribs are built to the bottom of pots and frying pans to obtain a maximum of heat. When the motor is idle the exhaust heat is forced through the burner. Sufficient heat is generated for any outdoor cooking.

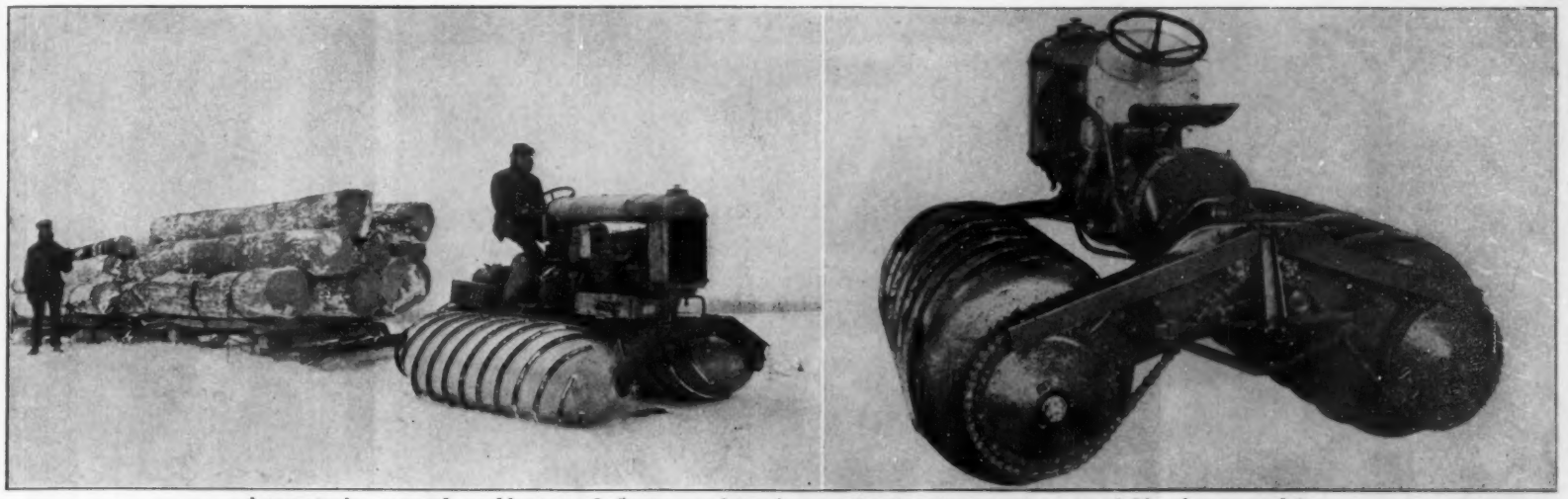
A Handy Flashlamp

A NEW flashlight, designed to aid the man who needs both hands on the job, has just been developed by a New York manufacturer. It differs from the conventional style of flashlight in that the lens is on the side instead of at the end. It is equipped with a steel clip which makes it possible to attach the flashlight to a belt or pocket and throw a beam of light upon the task to be done, leaving both hands free for the work. It is particularly adapted for linemen in the employ of public service corporations; for night repairmen in industrial plants; for maintenance gangs; for repair gangs on bridges, culverts, tunnels, et cetera, and for the lone motorist with engine trouble or a puncture.

French Railway Accidents

THE French have been having bad luck recently with railway accidents. In one case eleven passengers and a guard were killed. The driver was subsequently arrested because his speed recorder showed that the train was running at 58 miles per hour instead of the specified 25 miles per hour. There was considerable telescoping and a news dispatch says that the engine and first fourteen carriages, normally filling a length of 552 feet, were compressed into 390 feet.

A flashlight with the lens on the side



A tractor is mounted on blunt-nosed drums revolving in opposite directions passing over fields of snow and ice

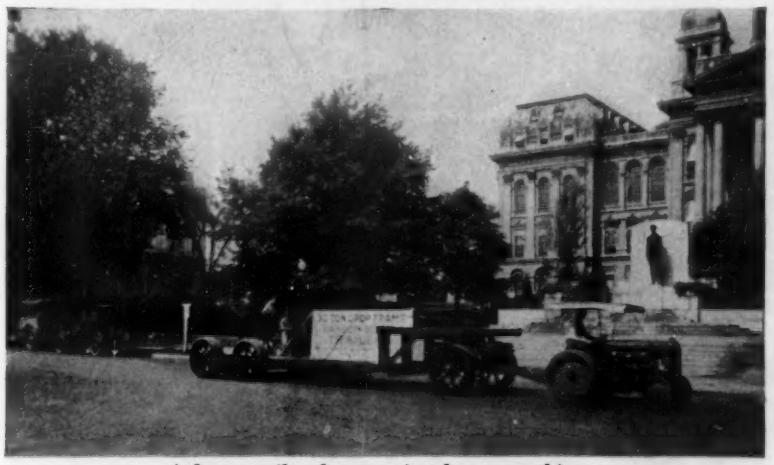
A Motor-tractor for Snow

THE running gear of the tractor shown on this page consists of two large, blunt-nosed drums revolving in opposite directions on lengthwise axles. Around the drums, in opposing spirals, runs a continuous vane or fin, called the "skate," which acts against the snow precisely as do the blades or buckets on the screw propeller of a ship. Once the clutch has been let in, the turning of the drums is controlled by the steering wheel. Each drum receives its power through a separate clutch which, depending on the position of the steering gear, engages or disengages. During recent tests, the snow motor has traveled, at twelve miles an hour, through snow drifts that balked a horse. To mount the tractor on the snow motor chassis it is necessary merely to remove the tractor's front and rear axles and wheels; then the driveshaft is connected to the special gearbox that contains the double steering clutch, the steering gear is hooked up, and the outfit is ready to go.

Headlight signal for automobiles

Are Your Lights On?

INASMUCH as the law requires that the headlights of a vehicle be lighted at certain times, it is important that the driver be able to determine whether his lights are on or off at all times. An inventor of Reading, Pennsylvania, has devised a simple means of conveying this information to the driver. The invention, shown on this page, consists of a relatively small reflector attached to the upper portion of the lens rim of the headlight, in such position that the driver will be sure to get a reflection of the lighted lamp. If he does not get such reflection, he will know that the lamp is out.



A huge trailer for carrying heavy machinery

Novel Luggage Carrier

A NEW luggage carrier is of particular interest in that it may be used for quite a number of hauling purposes by making slight changes in its position. It is adjustable to running boards of various lengths and may be folded down out of the way so that it will not detract in any way from the car's appearance. Four wing-nuts control the carrier, and sixteen different adjustments may be made. Three steel tubes are welded to steel end-plates and the entire carrier is mounted on the running board by four bolts. One end of the carrier telescopes so that one size of carrier may be adapted to any length of running board.

Largest American-built Trailer

THE trailer illustrated is of 30-ton capacity and was built primarily for the purpose of hauling glass-making machinery. The trailer weighs 10 tons. The bed is 9 feet wide and 20 feet long, the main body being 13 feet wide and 35 feet long. It has six wheels, two in front and four in the rear. The rear wheels are mounted on a main axle in tandem fashion, with a smaller axle connecting the forward and back wheels of each pair. The four back wheels are 40 by 12 inches in size and the two front wheels are 40 by 14 inches.

Front of the headlight

An automobile carrier with sixteen adjustments

The farmer can adjust the luggage carrier to hold milk cans

A portable router

An All-Around Router and Hand Shaper

WE illustrate two devices which are very useful in any shop and particularly so in the pattern shop. In the router which is shown in detail at the upper picture and in use in the two lower ones, the motor is in the head and rotates the router shaft to which the chuck is secured. The hand shaper fits the hand conveniently and consists of a small motor which does many small chores of heading, cutting or grinding.

Chlorine Gas Bomb Makes Possible Home Treatment of Colds

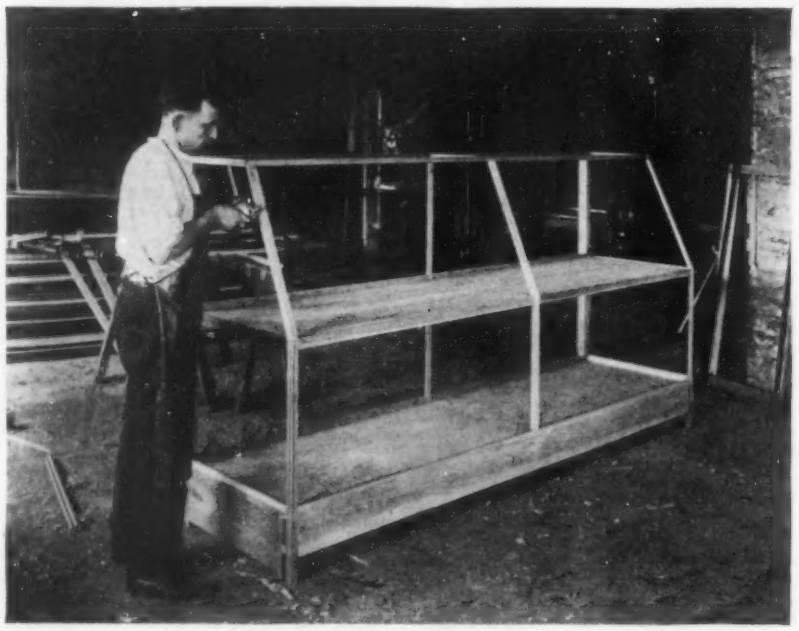
TWO San Francisco chemists have just perfected a chlorine gas bomb which makes possible the use of chlorine gas for the treatment of colds in the home, where the same results are obtained as with more elaborate apparatus. In fact, it eliminates the necessity of going to some central source for treatment, with possible exposure to bad weather and further lowering of body resistance. The chlorine gas bomb is made of glass and contains nothing but pure filtered chlorine gas. To use it, the patient takes the bomb in a closed room and breaks off the ends of the bomb, thus permitting the gas to escape and mingle with the air in the room. The patient remains in this gas filled room for one hour.

A Holder for the Elusive Slide Rule

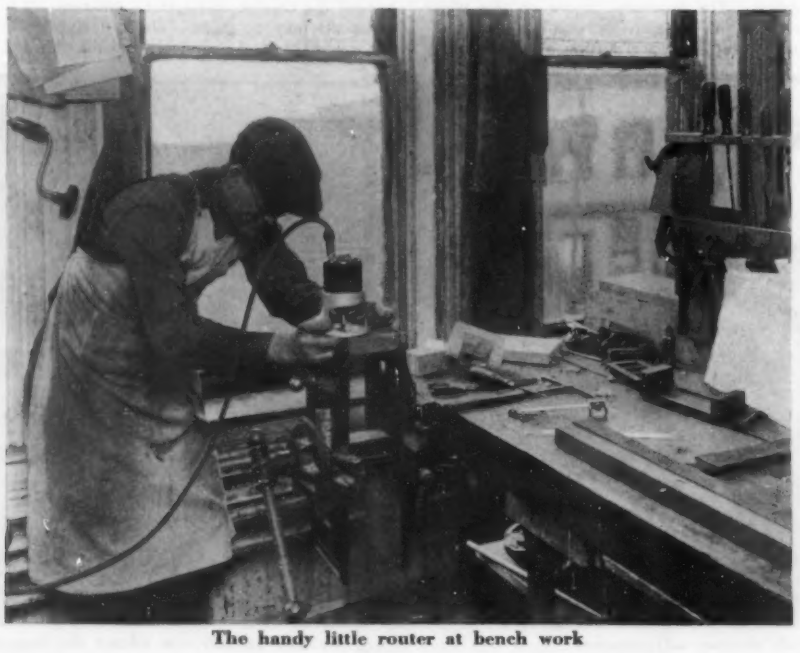
ONE of the chief services rendered by a new type of slide rule holder, having rubber pads underneath to prevent slipping when in use, is that it permits the time-study man, the accountant, the engineer or the mathematician to operate it, using only one hand, while the other hand is free for figuring and other work. The upper part of the slide rule holder is held against the rule with internal coil-springs and the slide rule can be inserted or taken out at will.

A slide rule holder that saves motion

The chlorine gas bomb is of glass and contains pure filtered chlorine gas



The portable hand shaper in use



The handy little router at bench work

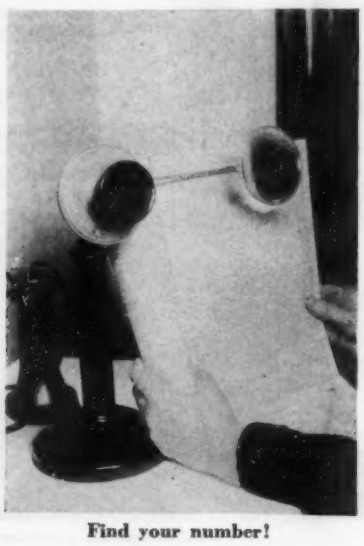
Protecting the alms box

Protecting the Poor Box

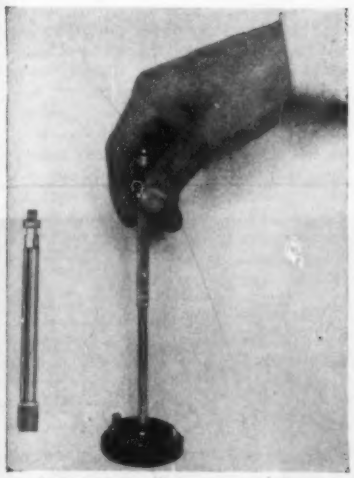
TO remove temptation from children and professional robbers, a Chicago safe man has recently invented and is now marketing a cleverly designed burglarproof safe, with three-inch walls, for use in Catholic churches to replace the usual candelabra box, in which offerings are deposited. Following an epidemic of robberies of church offering boxes in Chicago, many of these safes were installed, with the result that the robberies ceased. The safe has an ingeniously designed arrangement of chutes through which coins drop when placed in slots in the top of the safe. Three slots are used for receiving three kinds of offerings. The coins pass into a chute and fall into the compartment reserved for the particular denomination for which they are made. To prevent stealing of paper money and coins by the lowering of a sticky substance on string through the chute, the end of each chute has sharp teeth cut into it, thus preventing the return of anything passed into the safe.

Saving Your Eyes From Fine Print

A MAGNIFYING glass attachment for telephones enables the telephone user to find numbers in the telephone book quickly. The glass folds over toward the left when not in use, and is thus out of the way. This will be a great help to everyone who dreads the bulky volume with its fine type.



Find your number!



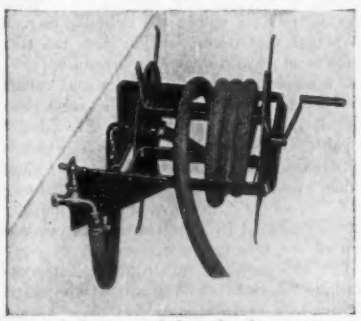
A temper-saving screw driver

Screw Driver Holds Screw

A RECENTLY patented screw driver is so made that it holds any screw by its slot. Because it is a small screw driver (7¼ inches long with ¼-inch blade) it starts screws easily in difficult places. By applying pressure on the top, two steel clips are released from the tool. When the screw driver is placed in the slot of the screw and pressure released these clips spread apart securing themselves tightly in the slot of the screw.

New Stationary Hose Reel

THIS is a stationary hose reel which may be attached to your house by a bracket. This reel has a short length of hose which connects the water outlet to the axis of the reel, where it is connected in turn to the ordinary section of garden hose length.

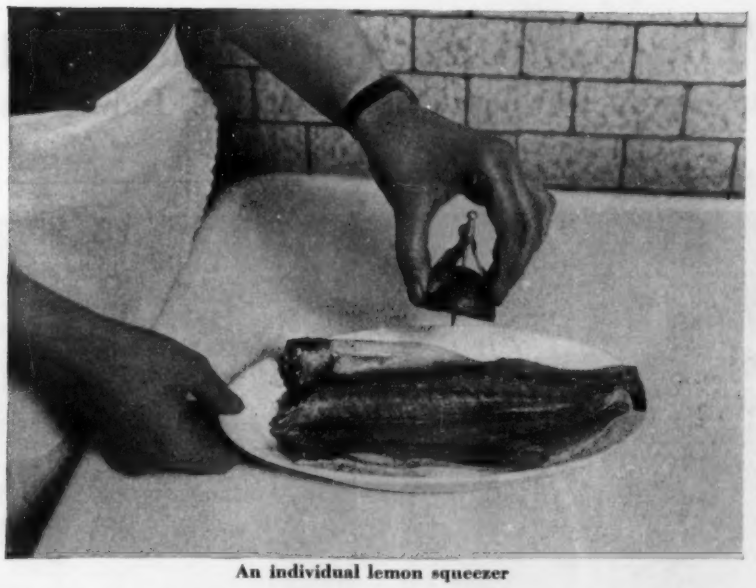


A hose reel for the house

A New Way of Teaching Geography

TO create interest in geography lessons, boys of the eighth grade manual training class of the Avondale Public School, Cincinnati, have made an electrical map of South America whereby the teacher, by pressing a button, can flash on one or more miniature lights concealed behind the map showing the location on the map.

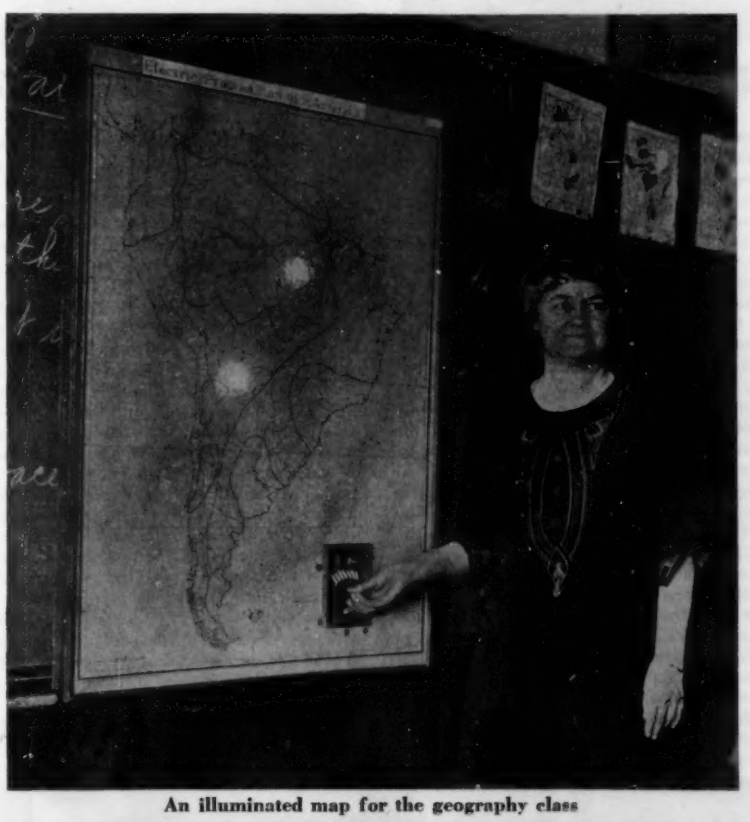
A mud guard that works



An individual lemon squeezer

Mud Guard for Pedestrians

THE mud guard pictured here is the invention of W. Peterson, a shipowner of Leith. This mud guard, which can be attached to any truck or bus, protects the pedestrian from the outward spatter of mud.



An illuminated map for the geography class

The ribs spread the heat

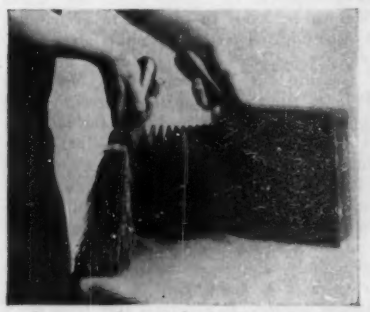
A porcelain sterilizer for toothbrushes

Sterilizes Toothbrushes

THE brushes are held by a porcelain disk with numbered holes for six brushes. A germicidal solution, the ingredients of which are volatile, is poured into the container once a week. No part of the brushes comes in contact with the solution.

A Woman's Idea of an Efficient Sweeper

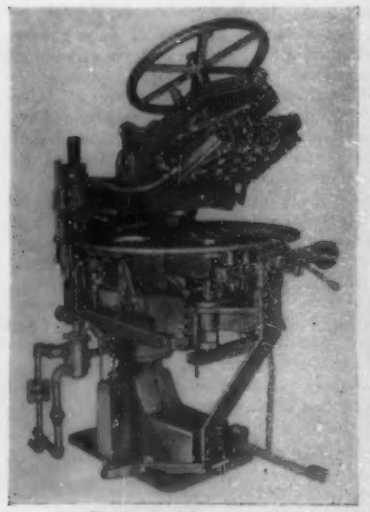
MRS. E. M. BOLTON, grandniece of Sir Humphry Davy, has invented a "concertina" stair-carpet sweeper. The dust is swept into the side tray as shown in the engraving.



A concertina stair-carpet sweeper

A Press for Plastic Substances

SO many objects now are made from plastic materials that special machinery is necessary to fabricate them. It is intended that this press be equipped with two sets of molds so that one set may be loaded and unloaded while the work in the second set is being pressed and cured.

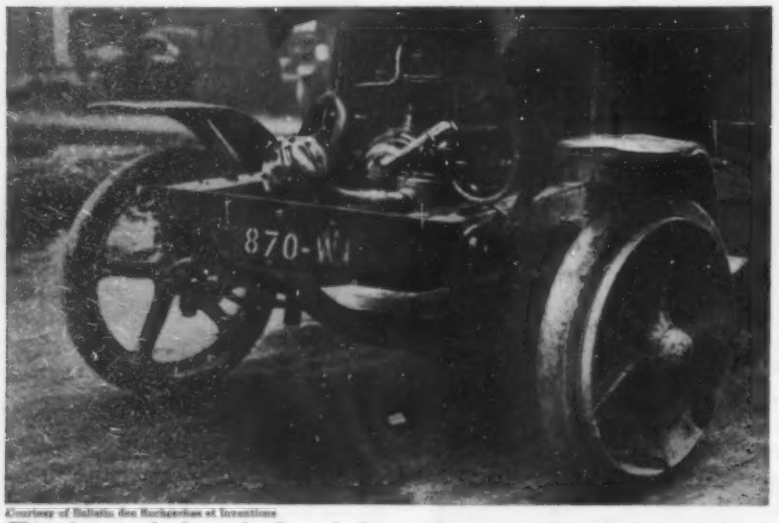


A plastic molding machine

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls



Courtesy of Bulletin des Recherches et Inventions

This photograph shows the Renault Gazogene motor truck, with the centrifugal purifiers set just ahead of the engine

Courtesy of Bulletin des Recherches et Inventions

The Vierzon Gazogene truck illustrates a type of installation similar to the Renault, but without such complicated purifying devices

Trucks Make Their Own Fuel

The accompanying photographs, showing a method of generating fuel gas for motor vehicles from charcoal, which has been rather extensively tried out in France, illustrates, to our mind, a tendency which has been apparent in Europe since the World War—a tendency to attempt to accomplish by complicated methods what is already being accomplished through simple means.

Gasoline, it is true, is expensive in France; and that nation feels insecure about its motor fuel supply, owing to the fact that it has no internal sources of gasoline. Gasoline must be imported, and a wartime blockade would bring about a situation that would be nearly fatal to a nation that is motorized even to the extent of France.

The "gasogene" generator is a cumbersome, bulky and heavy apparatus, attached to one side of a motor truck or to one end of a farm tractor. It generates fuel from charcoal. France is liberally supplied with sources of charcoal.

The apparatus consists of a generating chamber having a grate, firebox and boiler for producing the necessary steam for making the gas. It appears to be an amazing complication of internal "gadgets." The gas must be scrubbed, filtered to remove particles of charcoal, and further purified in a centrifugal purifier. There are a number of other details which it seems unnecessary to mention here.

The results of the tests of these gas-generator vehicles have been so far exceedingly satisfactory, according to the reports of the *Office National des Recherches et Inventions*. It was found that they can travel along an ordinary road at the rate of some forty miles per working day, hauling the regular maximum load of the truck.

On bench tests it was found that the motors developed nearly as much power as when running with gasoline. The gas utilized did not clog up the cylinders appreciably more than does ordinary gasoline.

As to endurance, the gas-generator-run truck is stated to be just as hardy and strong on the road as is the gasoline truck. And, most important of all, the economy of this fuel runs in France, anywhere between forty and seventy-five percent.

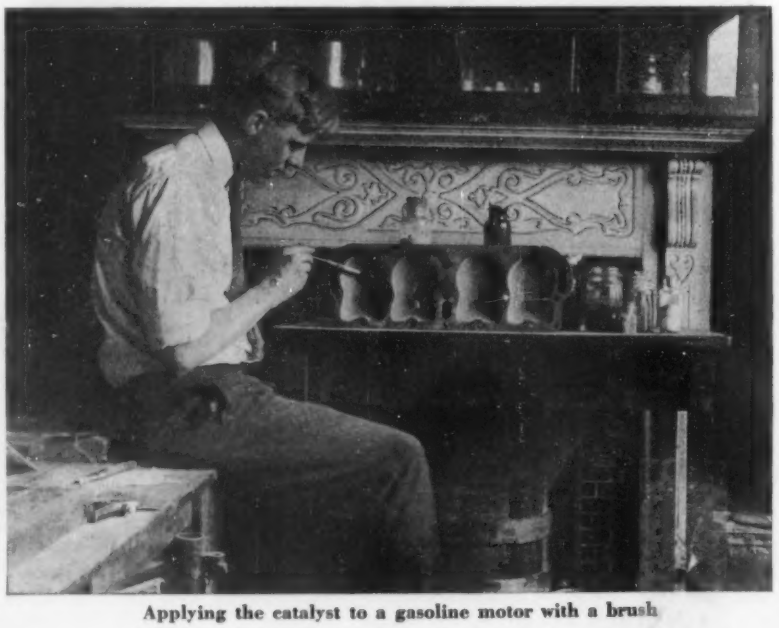
* * *

Aiding Digestion in Gasoline Motors

MUCH has been said regarding the available sources of petroleum and gasoline left in this country and authorities are more or less contradictory in their views on this important subject. But it remains a fact that our crude oil resources are being gradually depleted. The publicity that has been given to this matter has had one significant result, namely, an endeavor to improve the combustion of the gasoline-air mixture in the cylinder of the internal combustion engine, so that increased efficiency may be obtained and the consumption of fuel reduced.

Considerable attention has been paid to the incorporation of ingredients with gasoline to remove the "knock" in the engine and to increase its efficiency. The real value of such added ingredients, from all standpoints, still seems to be within the realms of discussion and experimentation. Another interesting and important method of developing more power in the engine and removing the "knock" forms the subject of this article.

The process of catalysis is well known in the chemical and allied industries. A catalyst is merely a substance which, through its very presence, makes it possible for certain chemical reactions to take place or which accelerates the speed at which they ensue. Catalysts are of various natures. Some are metals, others metallic salts; still others are compounds of the non-metallic elements. It is a fact that the catalyst does not change or diminish in quantity during the chemical reactions, but after a time it becomes fouled, loses its catalytic potency and must be replaced. This does not, however, have to be done except after considerable use has been made of the catalyst, so that one mass of the reagent will last for a very long time.



Applying the catalyst to a gasoline motor with a brush

The most recent application of catalysis is to accelerate the combustion of gasoline-air mixtures in the engine cylinder. The catalyst is applied to the head of the cylinder by simply painting it on, the active principle being incorporated with other ingredients to form a paint. The organic constituents of the paint are then burned off and the catalyst remains on the cylinder head.

An engine that has been treated in this manner possesses important advantages; for the catalyst, in accelerating the combustion of the gasoline by making it more complete, promotes the efficiency of the engine, with the result that greater energy is obtained from a unit amount of gasoline. This new development consists essentially of the application of catalysis to the process of conversion of chemical into mechanical energy in the cylinder.

Detonation, known as "knocking," is due to the decomposition of the unburnt fuel in the cylinder. It is a phenomenon which has been held to be brought about by too rapid combustion. But this theory is apparently erroneous. For it is a fact that certain substances added to the fuel tend to decrease the "knock." It, therefore, is plausible to conceive of the action of these substances as serving to increase the velocity of combustion of the fuel within the cylinder to such an extent that decomposition does not take place to so great a degree as heretofore.

It is understandable that a substance cannot both burn and decompose at the same time. This is the theory advanced by Dr. Edward Sokal, the inventor of the catalyst—which is called Katalite. Thus, contrary to the theoretical views usually maintained on this subject, "knocking" in the motor has actually been eliminated by accelerating the combustion of the fuel in the cylinder.

The active ingredient in the paint preparation, the catalyst, is a salt of the metal cerium. After this paint has been burned off from the cylinder head, an oxide of cerium is left. This cerium dioxide is the accelerating catalyst.

When the combustion of the gasoline-air mixture is accelerated, it is evident that leaner mixtures can be used than are now practical. Leaner mixtures catalyzed allow effective pressures to be obtained at lower temperatures, with the result that internal cooling of the engine is accomplished without entailing the loss of energy that is occasioned by external cooling. All this means greater fuel economy.

Extensive tests have been made with the new fuel economizer, and while results differ according to the design of the engine, and while under certain conditions it has been possible to augment appreciably its power production, in practically all tests it has been possible to duplicate the manufacturers' best performances with much leaner mixtures. Such motor engines as the Locomobile, Willys Knight, Ford and Packard Twin Six have been tested, and good results have been obtained in all cases.

In making a further analysis of the detonation problem it becomes evident that there are other ways of reducing "knocking," such as multiple spark plugs, and the central location of the spark plug; but all these remedies really accomplish nothing more than an increase in the rapidity of combustion. The use of a catalyst to accelerate the combustion of the air-gasoline mixture is the chemical method of solving this problem; and inasmuch as combustion itself is a distinctly chemical process, and since catalysis is known to have an extraordinarily great

accelerating effect on the velocity of chemical reactions, it is not surprising that it is so markedly effective. The important point to remember is that the fuel remains the same. Nothing is added or subtracted from the gasoline. All that has to be done is to paint the cylinder heads with the catalytic preparation. It is claimed that one application will last for 15,000 miles.

According to Ralph H. McKee, Professor of Chemical Engineering at Columbia University, who has been conducting some experiments with gas engines whose cylinders were treated with a catalyzer, the recently discovered accelerating action of catalysts, such as cerium dioxide, on the combustion of gasoline-air mixtures is theoretically correct and promises to go far in permitting us to meet our hopes of better working and more economical automobile engines.

* * *

A Wonderful Long-Distance Locomotive Run

ONE of the marked developments in the railroading of today is the tendency to increase the length of individual railroad runs, both the length of runs without a stop and also the total length of runs with stops made uninterruptedly by the same locomotive. The Great Northern Railway is greatly pleased, and justly so, by what may be regarded as the most remarkable engine performance to the date of Friday, September 25. On that day, the company's passenger locomotive Number 2517 left Seattle, Washington, at 4:30 in the afternoon with eighteen cars of raw silk and one passenger coach coupled up behind it, and made the run to Saint Paul without any stops, other than those for coal, water, and so on, in 52 hours and 35 minutes, reaching Saint Paul at 11:05 P.M. Sunday, September 27. This silk train, by the way, was the largest individual silk shipment ever transported in the Northwest.

The next morning, September 28, the same engine was coupled to train Number 27, which is the fastest long-distance mail train in the world, and left Saint Paul at 9:05 A.M. It made the through run from Saint Paul to Seattle, a distance of 1,789 miles in 47 hours 10 minutes, reaching Seattle on time (although it was delayed 20 minutes in starting from Saint Paul) at 5:15 A.M., Wednesday, September 30, the average running time being about 38 miles per hour. It should be noted that, because of the 20-minute delay in starting, engine Number 2517 made better time than the regular schedule of Number 27 by 20 minutes.

It will be seen that the round-trip performance of this engine, from Seattle to Saint Paul and return, a total distance of 3,571 miles, was 99 hours and 45 minutes, something which has never before been accomplished on any American railroad. It should be noted that the average distance traveled by a single locomotive running on the regular schedule is the distance between division points, which averages from 150 to 200 miles. How exceptional this performance was, is evident when the time consumed for fueling and watering the engine has been taken out; for in ordinary practice the replacing engine is already fueled and watered.

Courtesy of Hileman, Great Northern Railway Co.

At present the railroads are attempting to extend the average "run" of their locomotives, which is less than 200 miles. This locomotive made a 3,571-mile, practically continuous run from Seattle to Saint Paul and back

The fact that this was a stock engine and one of a fleet of oil-burning passenger locomotives which haul the Oriental Limited, and the further fact that it was not especially prepared for this great effort, renders the continuous round trip of 3,571 miles the more remarkable.

* * *

How They Do Petty Road Repairs in France

BEFORE the World War, France boasted of 900,000 miles of splendidly kept roads, built with crushed stone. The mobilization of every available Frenchman during the war and the necessity of confining road-repair work to those of the roads which were at or leading to the front, had the effect of allowing roads in the center, west, and south of France to deteriorate rapidly.

Formerly taken care of almost from day to day by the "cantonniers" or repairmen stationed in every village and on the outskirts of all the small or large communities, the roads of France after five years of neglect were found to have been damaged to such a degree that in many cases it was necessary entirely to rebuild large stretches of the important "national" highways.

The necessity of paying for the war and rebuilding the devastated regions did not allow for the adoption of a lavish policy in this matter, for the cost of such work was prohibitive.

In each case the government experts had to choose between two policies: either to replace a large proportion of the roads by new roads built with the strongest materials known to modern engineers; or to repair methodically and with perseverance the existing damage to the present roads. The second policy has been followed out, but old methods had to be replaced by new and better ones.

Before the war the "cantonniers" had several tasks to perform. The ditches along the road had to be constantly watched and cared for in order to permit of the drainage of rain water. Weeds and other plant-growth had to be removed from the road-side lest they invade the road itself. And lastly, the road worker would go from hole to hole and from rut to rut, filling them with the rocks which he had broken by hand and which were kept in little heaps beside every road. Those who motored through France before the war will recall the busy men breaking stones with sledge-hammers at the roadside or sweeping pebbles from the highway with large brooms.

The modern method is more expensive, but it is said to be far more efficient and rapid. The equipment used also represents a greater initial expense and a higher operating cost than the cost of the pre-war manual labor.

The work of repairing holes in the French roads is undertaken in much the same manner as that of a dentist who fills a cavity in a tooth. The cavity is first located, the road is dug up around the cavity, and a "filling" is inserted.

A rectangular outline is drawn in chalk around the rut or the hole, and then a workman with an electro-magnetic pick-axe proceeds to break up the road within the outline. The debris is cleared away, and the new material is prepared for filling the excavation.

Then the cavity is filled in and pounded in with an electro-magnetic tamping machine. After the filling-in process, the surface of the road is remodeled exactly to its original level, and the job is done.

The electro-magnetic pick-axe is a powerful tool, driven by an electric motor, and both the tool and its motor are supported by an axle suspended between two wheels. The workman grasps two shafts connected with the axle, and thus guides the tool over the ground; the force and depth of the blow can be gauged by bearing down on the shafts.

The tool strikes sharp, powerful blows and does not scatter the material dug. There is no known road material that can resist its cutting edge. The power which operates the motor is derived from overhead wires by a trolley attachment. This permits the tool or tools to operate over a considerable area of the road without moving the generator which provides the electric current to the motors.

After the hole has been dug, the filling materials are mixed by hand, because mechanical mixing machinery would not be practical for the detail work for which the apparatus is designed. In every case, whether the road be of concrete, crushed rock, or macadam, the material previously used in the road is made the basis of the filling, and similar materials are added if there is not enough. The holes are filled by hand, and now the electro-magnetic tamper comes into play. It operates with great speed and strength, leaving the surface of the road in much the condition in which it stood after the steam-roller finished its work when the road was first built. The tamper, like the "pick-axe" or road breaker, is provided with a motor and is carried on an axle between two wheels, with shafts handled by the operator, and the electric energy is obtained from the trolley attachment.

The entire repair squad is composed of a dozen men, and all the men and their equipment are carried on a single truck. This truck contains an electric generator driven by a gasoline motor. While repair work is in process a number of low towers provided with the proper insulation are erected at intervals along the road, bearing the power wires from the truck. The latter remains stationary while work is carried on over a distance of several hundred feet.

As soon as a stretch of road is repaired, the ladders and power wires are removed and the truck proceeds to work on a new location.

F. M. Delano

In France, road repair work is done by means of an "electromagnetic pick-axe" which opens up small damaged spots

F. M. Delano

The opening made by the electromagnetic pick-axe is filled and another tool is attached to the motor for tamping

Seeing in the Dark

It is a matter of common experience that insufficient road illumination and glaring headlights make night driving conditions far from satisfactory. Various devices—special lenses, reflectors, and so on—have been presented to relieve or to cure these conditions, but glaring headlights still levy their toll of accidents, and statistics show that even more accidents are due to insufficient road illumination. Yet, an immediate and far-reaching improvement in night driving conditions would be effected if motorists realized the following two facts:

(1) With the majority of headlamps now in service, proper adjustment is all that is necessary to obtain greatly improved road illumination, and at the same time to eliminate objectionable glare.

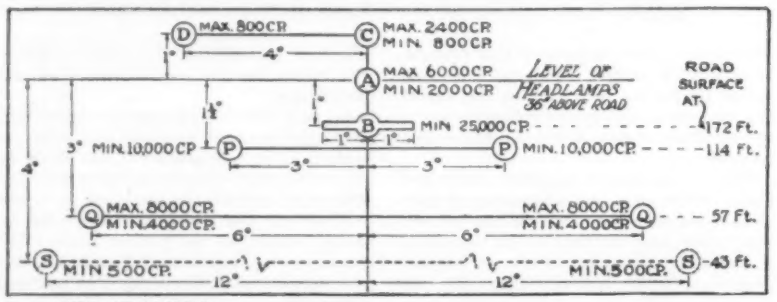
(2) A driver who makes the proper adjustments now, without waiting for others to make them, not only removes the irritation he is causing other motorists, but also provides for himself a road illumination that is better and safer, and one that makes it easier for him to pass cars with glaring headlights.

From the two small headlamps, mounted three feet above the road, a way must be found to direct a path of light over its entire surface for 200 feet or more ahead; a little light close by and to the sides to illuminate roadside and ditch and to assist in making sharp turns, and tens of thousands of candlepower just below the level of the headlamps to reach well ahead and reveal obstructions, turns, crossroads, and dead-end streets. At the level of the headlamps and slightly higher there must be some light to reveal pedestrians, and anything that overhangs the road before one is upon it. But here the intensity of the beam must be closely limited, unfortunately, to a small fraction of that needed just below the level of the headlamps if the approaching driver is not to be blinded in its dazzling glare—actually to much less than is necessary to reveal the road far ahead for fast driving.

The best compromise must be effected between the need for a high candlepower to reveal objects ahead, on the one hand, and, on the other, the necessity for controlling the light above the lamp level so that while some glare remains, serious interference with vision is avoided. The chart shows the limiting candlepower values in the directions of the different points indicated on the photograph, needed to insure such a beam.

Courtesy of National Electric Light Co.

The beam must be toed-in, so that it misses approaching traffic



Courtesy of National Electric Light Co.

This diagram is directly analagous to the illustration above

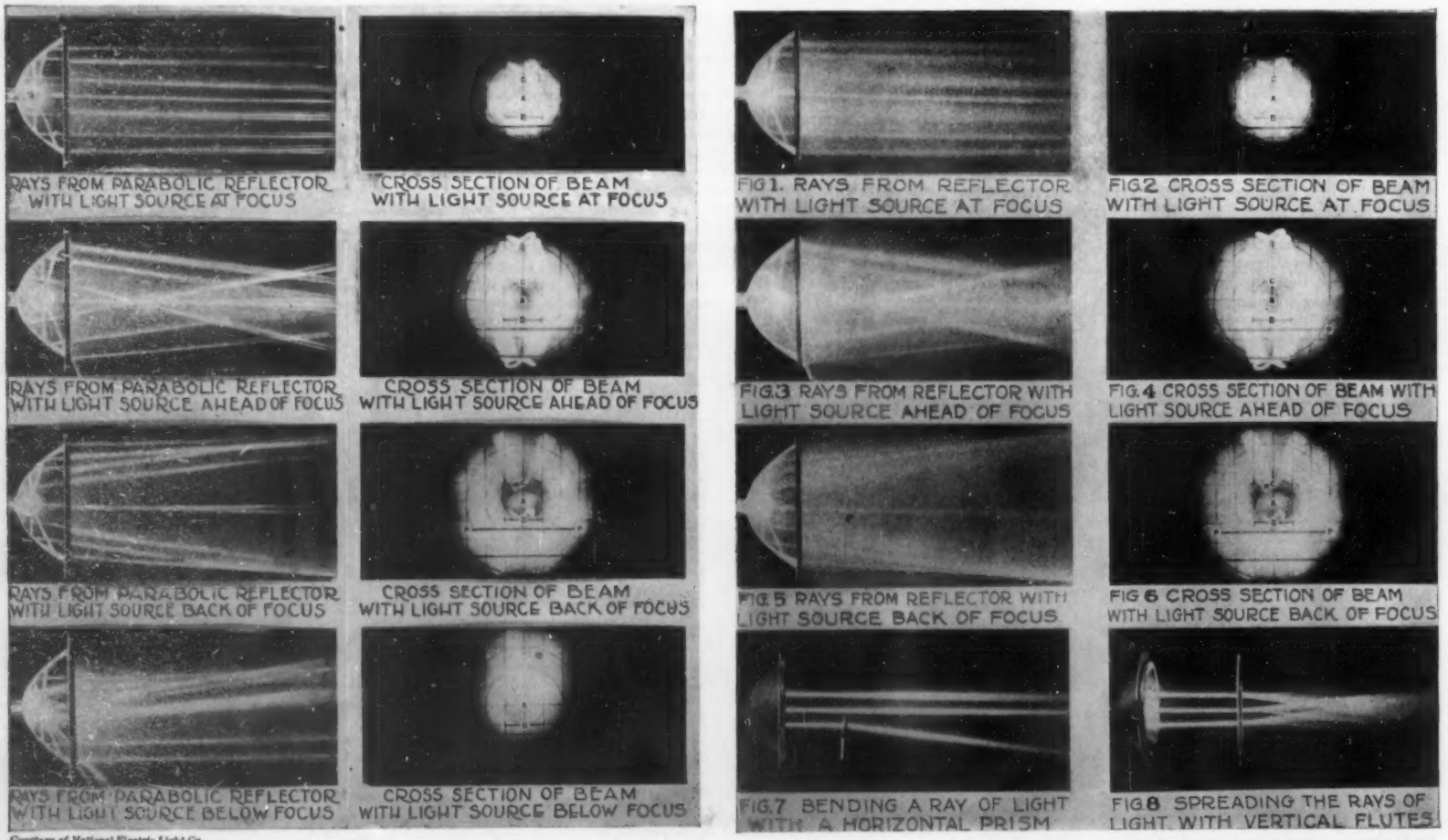
Modern headlighting regulations of many states are based on a similar system specifying minimum performance.

The desirable type of beam, as indicated, utilizes the light from the headlamp bulbs most advantageously. But in doing this the light is taken from all directions and concentrated in a narrow zone. Darkness remains all about. There is no light in the direction of road signs or house numbers; the beam is not wide enough to guide one safely around the sharp curves of an unfamiliar road except at the slowest speed. On sharply hilly roads the beam is often completely lifted off the road or, striking a steeply ascending grade, is cut off just ahead of the car; and for fast night driving, safety always requires more light above the horizontal than is obtained with the approved headlight equipments. Spotlights supplement the headlighting adequately under any of these conditions and may be needed to substitute for the headlamps in an emergency. Judiciously used, the spotlight is valuable from the standpoint of all concerned, while injudiciously used it may pave the way for legislation penalizing the majority for the inconsiderate acts of a very few. Fortunately, the greatly improved headlighting conditions today over those of a few years ago have almost entirely removed the occasion for misuse of this valuable accessory. No car should be without a good spotlight.

No matter how well designed or efficient the headlamps on the car may be, good road illumination without blinding glare cannot be expected unless the bulbs are accurately adjusted in the reflectors and the beams are properly aimed. State approval on a particular lens or special reflector means simply that the device is so designed as to be capable of distributing the light in a satisfactory manner—but only when properly focused and aimed.

Given good equipment, with the optical parts clean and shiny, all that is needed to insure good results is adjustment, which means two things: (1) Focusing the lamps; (2) Aiming the beams.

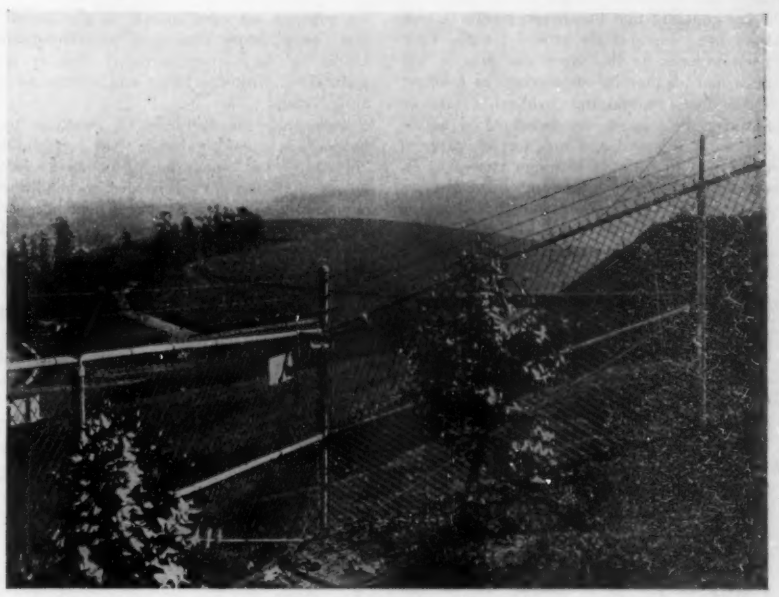
"Focusing the lamps" is an imposing technical phrase to describe the simple opera-


RAYS FROM PARABOLIC REFLECTOR WITH LIGHT SOURCE AT FOCUS
CROSS SECTION OF BEAM WITH LIGHT SOURCE AT FOCUS
FIG 1. RAYS FROM REFLECTOR WITH LIGHT SOURCE AT FOCUS
FIG 2 CROSS SECTION OF BEAM WITH LIGHT SOURCE AT FOCUS
RAYS FROM PARABOLIC REFLECTOR WITH LIGHT SOURCE AHEAD OF FOCUS
CROSS SECTION OF BEAM WITH LIGHT SOURCE AHEAD OF FOCUS
FIG 3 RAYS FROM REFLECTOR WITH LIGHT SOURCE AHEAD OF FOCUS
FIG 4 CROSS SECTION OF BEAM WITH LIGHT SOURCE AHEAD OF FOCUS
RAYS FROM PARABOLIC REFLECTOR WITH LIGHT SOURCE BACK OF FOCUS
CROSS SECTION OF BEAM WITH LIGHT SOURCE BACK OF FOCUS
FIG 5 RAYS FROM REFLECTOR WITH LIGHT SOURCE BACK OF FOCUS
FIG 6 CROSS SECTION OF BEAM WITH LIGHT SOURCE BACK OF FOCUS
RAYS FROM PARABOLIC REFLECTOR WITH LIGHT SOURCE BELOW FOCUS
CROSS SECTION OF BEAM WITH LIGHT SOURCE BELOW FOCUS
FIG 7 BENDING A RAY OF LIGHT WITH A HORIZONTAL PRISM
FIG 8 SPREADING THE RAYS OF LIGHT WITH VERTICAL FLUTES

Courtesy of National Electric Light Co.

The reflecting element of the automobile headlight is a parabola with but one focus. It is necessary to adjust the light-source until it occupies that exact point

In California, when it was found necessary to irrigate land bordered by a fence, the top pipe of the fence was utilized as the water main



A section of the fence, showing how expansion due to heat was taken care of by means of a swing joint at the corners of the long sections

tion of moving the lamp bulb a little ahead or back by means of that ordinary tool-kit implement—a screw driver; while "aiming the beams" is just that—tilting the headlamps downward and swinging them from side to side as one would nod or turn his head, until the beams point straight ahead at the right up-and-down angle. This will probably require the services of no more complicated an instrument than an ordinary monkey wrench.

When you move the bulb ever so little in the reflector something very noticeable happens to the beam. Look at the pictures. These are actual photographs of three types of beams obtained from the same lamp and reflector.

None of the three beams shown are of a satisfactory type to answer the requirements of good headlighting, because all of them are round, while what we really need is a flattened form of beam. This desired type is obtained either by using a lens on a reflector of the type shown, by using a reflector with especially designed contours, or by a combination of the two. In any case there is always some one position of the lamp bulb which gives us the best shape of beam. Focusing should be done with the lens in place and this is all there is to it—simply moving the bulb a little ahead or a little back in the reflector so as to marshal the rays into an orderly formation that puts the light where it is wanted.

One fundamental principle frequently used for this purpose is the fact that a wedge or prism of glass will bend light rays off at an angle. The shape of the wedge or prism together with its position determines where the light ray that passes through it will be directed.

Place the car on a level stretch with the headlamps 25 feet from a light-colored vertical surface.

Some means, which can be determined upon examination, is customarily provided for moving the bulb backward and forward in the reflector, usually a screw head projecting from the rear of the headlamp. Cover up one of the headlights. Now, move the bulb in the other back and forth and notice the changing patterns on the reflecting surface. Our object is to get a light pattern as shallow as possible in the up-and-down direction with the top edge of the pattern sharply outlined. The brightest part of the pattern should be as near the top of the beam as possible because this is the part of the beam that lights the road far away. If your bulb is of the ordinary single filament type take it out and turn it over in the socket, and use it in the position which best fulfills the foregoing condition. Focus the other headlamp in the same way.

Next aim the beams so that when the car is fully loaded the tops of the beams will be directly ahead of and at the same level as the headlamp centers. If, when the car is empty, the beams are aimed to meet the requirements, loading the car fully will tilt them upward into the eyes of approaching drivers. Therefore, if the car is not loaded when the aiming is done, an allowance must be made in the tilt of the headlamps.

Measure the height of the headlamp centers from the floor, and, if the car is empty while you are making this adjustment, subtract a loading allowance figure of from 5 inches for 140-inch wheelbase to 8 inches for 110-inch wheelbase, and draw a horizontal line at this level on the vertical wall. Then draw bisecting vertical lines the same distance apart as the centers of the lamps.

A universal joint or a slot under one of the bolts fastening the headlamp to the fender or frame is usually provided to facilitate aiming. With one headlamp covered, center the pattern below the bisecting point directly ahead so that its upper boundary is on the horizontal line.

Cover the adjusted headlamp and repeat the operation on the other one.

Check your headlighting occasionally.

At reasonable intervals, the adjustment should be checked roughly to be sure that vibration and handling have not changed the focus and aiming. Throw the beams against a vertical surface or view them from about a hundred feet ahead of the car and see that the top edge of the beam is at about knee level.

Incorrect voltage on the lamps is sometimes the cause of unsatisfactory headlighting. If the lamps seem to burn with a dim or yellowish light, a low voltage is indicated; this may be due to poor contacts in the lamp circuit or to an under-charged battery, which is frequently the result of a generator charging rate too low to replace the electrical energy used by the starter, lights, and other electrical equipment on the car. Repeated early lamp failures indicate a high voltage on the lamps; this may be caused by poor contacts in the battery circuit, by lack of water in the battery, or by an over-charged battery, caused by an excessive charging rate.

In either case, the condition of the battery and of the circuits should be inspected, preferably at a service station, in order to avoid the danger of serious trouble, as well as to obtain satisfactory lighting service.

Good headlighting, therefore, resolves itself into the use of good equipment and the correct adjustment of that equipment. Both of these conditions are necessary and each is dependent upon the other. Most of the headlight troubles at present are due to poor adjustment. A good safe driving light for the pleasure and safety of the motorist is the spirit of all headlighting laws. Headlight adjustment is not intended primarily for the other fellow's benefit—it is for your own.—Abstracted from a booklet written by Dr. M. Luckiesh, Director, Lighting Research Laboratory, National Lamp Works of the General Electric Company, and Corresponding Editor of the Scientific American.

* * *

Combining Fencing and Irrigation

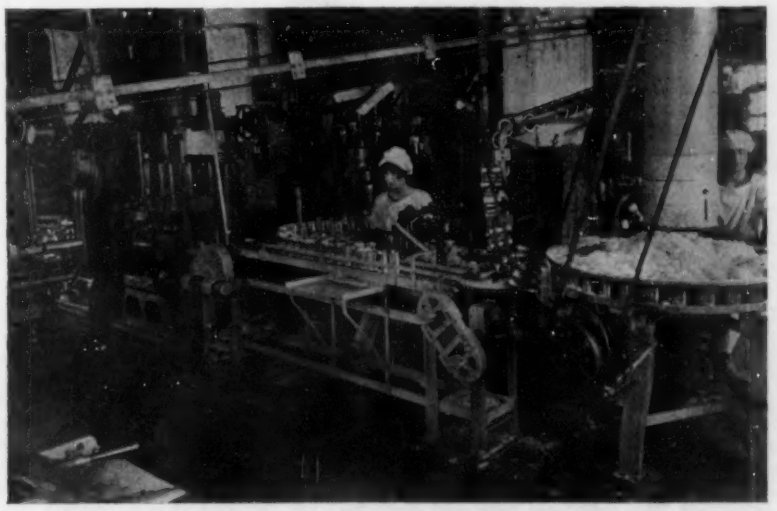
THE idea of the top rail of the fence carrying water to irrigate the Forest Lawn Memorial Park in Glendale, California, was worked out by the Southern California Fence Company. The cemetery is located on a hillside, the highest point being about 1,800 feet above sea level. Coincident with the question of fencing was the problem of how to irrigate and water the vines which were to cover the fence.

The first idea was irrigation by an underground water line system, except at the highest points, where the water was to be conveyed by buckets. This, however, involved too great a cost. It was finally decided that the underground system could take care of the low portion of the ground. The slope is to be irrigated by making leads from the top rail of the fence at intervals to desired locations infield. In this manner the property owners were spared the expense of laying main underground supply lines.

The fence is approximately 13,000 feet in length, the top rail being 1¼ inch pipe. The water supply is taken from a storage tank at the highest point of the fence line. Along this fence English ivy vines have been planted about one foot apart and eucalyptus trees about five feet away from the fence and 12 feet apart. This planting is continuous around the entire property, except for 300 feet at the entrance gates. In watering these trees and vines a hose is connected to the valves in the rail and operated by hand.

One question about this installation was that of caring for contraction and expansion of the pipe, as some of the straight lines are more than 3,000 feet long. A swing joint was constructed in the pipe line at the fence corners forming the circuit. This safeguard, plus the manner in which the wire was fastened to the water pipe, solved the problem.

The Forest Lawn Memorial Park is one of the most beautiful cemeteries in Southern California, being situated among the hills on the borders of the cities of Glendale and Los Angeles. It consists of about 212 acres entirely enclosed with fencing. When the planting along the fence attains its maturity the fence will be almost entirely covered with English ivy, forming a dense screen. The eucalyptus trees will form a hedge line which, in time, will extend 200 feet high.



Food products and tobacco packed in an atmosphere of inert gas, instead of oxygen, do not lose their desirable qualities

* * *

Food Preservation by Inert Gases

IN 1922 the Scientific American published a short article giving the results of the experiments made up to that time in the preservation of foods.

At that time great hopes were entertained that the inert-gas packing process would be very generally applicable to food preservation. To a great extent these hopes have been fulfilled, says Mr. Thomas M. Rector, author of "Scientific Preservation of Food."

In general, the beneficial results which have been conclusively proved for the Vitapack process, as this inert gas process has been named, may be summarized as follows:

All foods containing oxidizable oils or flavoring substances are benefited if active oxygen is removed and an inert atmosphere of carbon dioxide or nitrogen gas—that is, one which will not enter into chemical combination with the food—is substituted for it. Foods, such as nuts of all kinds, dry milk, candies containing butter fat, and others, fall into this class. Foods which are subject to the attack of molds (which ordinarily require oxygen for their development and growth) are also protected by the effects of an inert gas atmosphere.

In order to secure freedom from the action of bacteria and yeast, it is usually necessary partly to dehydrate the food in order that it may be protected from molds by the gas process, and this is now being done in the case of canned coconut, to the extent of ten million cans per year. So effective is this process in the case of nuts, that it now permits cashew nuts, a delicacy of India, to be brought ten thousand miles to this country in perfect condition. Before the development of this process, these nuts almost always arrived badly infested with worms. Most of them were in such bad condition that the Department of Agriculture was compelled to condemn them as unfit for human consumption.

Canned coconut was the first product to which this system was commercially applied. Coconut is a milky white product which spoils very readily. When attempts were made to can it, it soon turned black in the cans, presenting an unappetizing appearance.

This was due to the fact that the oxygen occupying the space between the threads of coconut attacked the tin can, producing black metallic oxides. These oxides rubbed off on the coconut, blackening the threads. The obvious remedy was to remove the oxygen as thoroughly as possible and this was best accomplished by the substitution of an inert gas in its place.

When this process was put in use it was found that not only did the coconut remain in a pure white condition, but the flavor was very much superior to that canned without inert gas. The cause of this was traced to oxidation of the coconut oil and it was then realized that an unanticipated advantage had been secured.

No advantage has been attained in the preservation of liquid milk, either in its natural state, or condensed; but in the infant dried-milk industry it has fitted in well. Dry milk, which is simply milk which has been evaporated to a powder, is a very delicate product and is extremely sensitive to the influence of the atmosphere. By packing it in an atmosphere of inert gas, in a hermetically sealed container, it has been possible to preserve dry milk for as long as three years, with no signs of rancidity. Ordinarily, rancidity in dry milk exposed to the air in an ordinary metallic container may be expected to show in from two to four months. This, however, is not long enough to allow the milk to pass from the factory to the consumer, and the fact that an occasional can has reached the consumer in a rancid condition has been a great detriment to the development of dry milk. Dry milk packed by the Vitapack process is now being sent to all parts of the world.

In dry milk, the predominant cause of spoilage is again the oxygen of the air, and if this air be all removed and a chemically inert gas be substituted, there can be no oxidation. Because the milk powder is extremely dry, danger from insect infestation and the growth of molds is very slight.

In the enormous tobacco industry a great deal of experimental work has been done, and two or three firms are already putting out tobacco packed in inert gas, in commercial quantities. It has been predicted that within a year, 75 per cent of the plug tobacco of the Dominion of Canada will be packed in hermetically sealed containers. This is because the long dry winters of Canada are very detrimental to the "condition" or moisture content of tobacco of all kinds, so that it is necessary that it be maintained with the flavor and moisture exactly right.

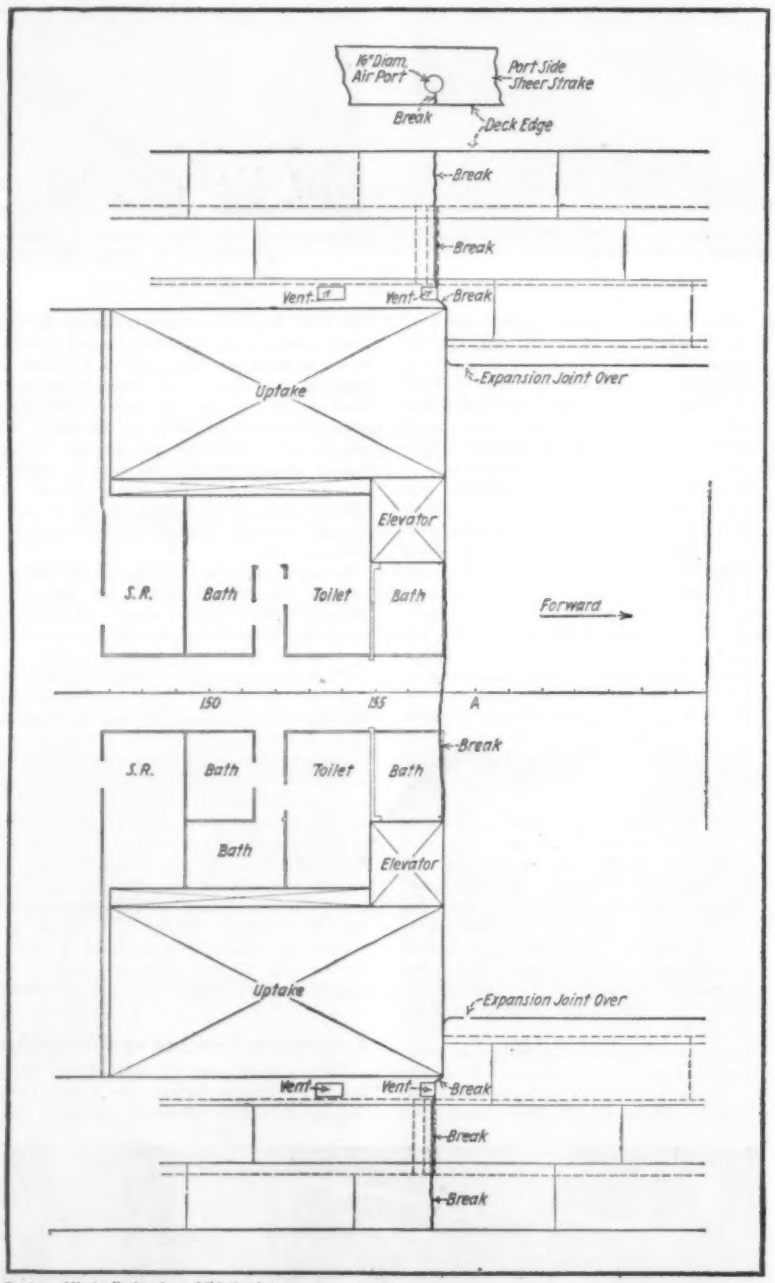
This fact also applies to smoking tobacco, cigars and cigarettes. The mysterious "blending" or "smoothing" processes which go on in tobacco aged in proper condition are greatly benefited by this system because none of the flavoring oils can be lost, and therefore, the tobacco is really aged in a flavored atmosphere, which is conducive to proper blending.

It has been found that practically all nuts, including walnuts, pecans, brazil nuts, filberts, cashew nuts, pistachio nuts, and others more rare, can be kept as long as desired, if properly prepared in advance. The preparation consists chiefly in proper drying. Since these facts were established by research, several firms have started packing shelled nuts in sealed tin containers.

During the World War, and for a time afterward, there was a great deal of enthusiasm among food manufacturers about dehydrated foods. This enthusiasm was largely based on the extreme claims of manufacturers of drying equipment and others that dehydrated foods would keep forever, once the water was removed. However, there is no dehydrated food—with the exception of those practically chemically pure, such as sugar and starch—which will keep indefinitely under ordinary atmospheric conditions. Insects, molds, and rancidity caused by oxygen—all take their toll.

Loss of flavor by evaporation and by other causes also comes into play. Therefore, manufacturers who packed their dehydrated foods in paper cartons and put them on the market, soon found that their products began to spoil within a few weeks.

It should be quite obvious to anyone, even the manufacturer of dryers, that the future of this very important industry depends on being able to convey the product to the consumer in such condition that when it is soaked in water it comes back to a condition resembling that of the fresh fruit or vegetable. This, it is claimed, can be accomplished better by the inert gas system than by any other method.



Courtesy of Marine Engineering and Shipping Age

Looking down on C deck of the *Majestic*, showing the break that extended entirely across it and started down the side

* * *

Why "Majestic" Was Laid Up for Repairs—Faulty German Design

LAST winter, the *Majestic*, the world's largest steamship, was making her westward passage in rough weather when a loud report, likened by many to a cannon shot, was heard. An investigation showed that the C deck of this mammoth vessel had cracked open all the way from the starboard to the port side, the crack even extending a short distance down the side of the ship. She was able to make port, one day distant, and to return to England, where she was laid up for repairs.

This is the report of Edward Ellsburg, a naval constructor of the United States Navy, contained in the August, 1925, issue of *Marine Engineering and Shipping Age* (New York).

It would appear from Mr. Ellsburg's account that it was discovered, during the summer of 1924, that the C deck of the *Majestic* was fractured at the midship section. The C deck is the strength deck of the vessel, but it had been largely cut away by two elevator shafts and two uptakes which cut the double plating. This construction, according to this United States naval constructor, results in leaving only about twenty-five percent of the beam of the ship intact inboard of the elevators and uptakes.

This plating near the center was not intended to take any strain and was made only five-eighths of an inch thick, as compared with the deck-stringer plating which is about two inches thick at the side and about one and one-half inches thick in the strakes next inboard.

It was the section of five-eighths-inch plating between the elevators which was first discovered to have parted, but at the time little importance was attached officially to the fracture. As this light plating was not the strength plating, the vessel was not considered weakened and, as it was then in the midst of the tourist rush, nothing was done to remedy the damage. It was apparently intended to defer repairs to some slacker period in the future.

However, says the United States naval constructor, "a little reflection, and a further investigation at this time as to how a light strake could ever get sufficient strain to let go when there were outboard of it heavy strakes intended to take all the strain, would have proved both illuminating and profitable. There can be no doubt," he continues, "that such an investigation would have shown the deck stringers on both sides already fractured through a considerable portion of their width, so that the strains in working had been partly thrown on the light strakes inboard, with the consequences noted."

The C deck was concealed by wood planking; and underneath, the stateroom ceilings sheathed it, and "if anyone connected with the ship had any doubts, they were not strong enough to cause the laying open to inspection of the deck stringers, and no examination of them was made."

Matters continued in this status until the westbound trip in December, with rough weather, and it was then that the loud report, like a cannon shot, was heard. The C deck had let go clear across; the port shear strake had already let go, so that the crack started down the side until it met and was stopped by a porthole not far below. But the ship made port all right and sailed east again according to schedule. The crack opened now about one-half inch as the ship worked, but the weather was now not bad and Southampton was reached where the ship was laid up for repairs. The wood decking and the ceilings below were ripped out.

Then it was found that although an opening had been cut for the uptake hatch, there was no compensation for it fitted around the corners of the opening. This and other factors produced a line of weakness and, in addition, failure to compensate the heavy deck for the openings cut in it, resulted in concentrating all the strain carried from forward by a much wider strake of heavy plating. The fracture was progressive. This occurred in the summer of 1924, and it was only in December, in rough weather, that the remaining metal of the top flange of the deck let go with a bang.

Just why the German designer of the *Majestic* failed to compensate his strength deck when he cut out an oblong section of it on each side is not known.

The *Majestic* was repaired with heavier materials than the origir d, and is now in regular service.

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Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics

Pacific and Atlantic

This is not a helicopter. When the usual airplane type of propeller moves the craft forward, a huge windmill is set into rotation and the area swept out by the windmill blades being inclined to the line of the wind, acts just like a fixed wing in providing lift

La Cierva's Autogiro

LA CIERVA'S Autogiro of which such interesting reports have recently appeared in the daily press, is *not* a helicopter, that is, a machine in which a power-driven airscrew provides the sustention or lift of the craft. It is based on a different principle.

As shown in the photograph, it is constructed with an airplane fuselage, the usual type of landing gear, the ordinary type of rudder and elevator controls, with ailerons of the usual type carried on tubes from the lower part of the fuselage, and the customary type of engine-driven propeller to secure forward movement. But instead of having fixed wings, it is supported in the air by a large four-bladed windmill, perfectly free to rotate on a long shaft, inclined slightly backwards emerging from the front cockpit and braced by a pyramid of steel tubes. As simple experiment will show, a windmill, suitably designed, will rotate in a side-wind, although the aerodynamics of the side-wind rotation are somewhat intricate. As the windmill rotates, any element of the blades meets the air just like a wing section and, therefore, provides lift. The windmill, therefore, becomes the equivalent of a lifting surface. If the tail is depressed and the shaft inclined back from the vertical, the plane of rotation of the windmill is at a bigger lifting angle and just as with an ordinary wing the lift for a given wind speed increases. There is no perpetual motion in this functioning of the windmill; it only rotates and provides lift if the airplane propeller is dragging it forward with energy supplied by the engine.

The newspapers speak of a combination of flapping and rotation. The device has no flapping wings, properly so-called, but the blades of the windmill do move up and down slightly as they rotate, and that for a very important reason. Imagine the blade on the lift side going forward into the wind of the forward motion of the Autogiro, and the blade on the right side retreating from this wind. Evidently, the blade on the left side is meeting the air at a greater resultant velocity than the blade on the right side. If the blades were rigidly fixed to the shaft, the Autogiro would have more lift on the left side and would constantly tip sidewise. M. La Cierva spent several years in overcoming the difficulty. The final solution is most ingenious. The arrangement adopted is shown in our sketch.

The blades of the windmill *a* are attached to the collar *b* which is free to turn about the shaft *f*. But they are hinged at the point *e* so that they are free to take up various positions, as shown dotted in the sketch. Rubber bands *s* prevent the blades from coming too far down, when they are at rest. The blade moving forward on the left side does momentarily experience a greater lift than the blade on the right side sailing away from the wind, but owing to this momentarily greater lift, the blade on the left side rises. As it rises, it meets a down wind which automatically diminishes its lift. There is, therefore, an automatic and perfect lateral balancing, with the blades of the windmill moving up and down through a few degrees as they rotate.

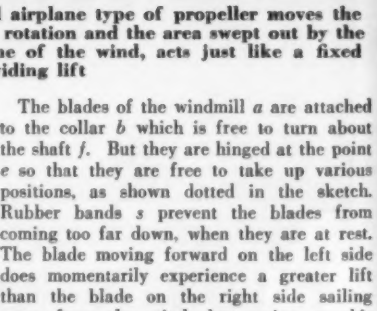
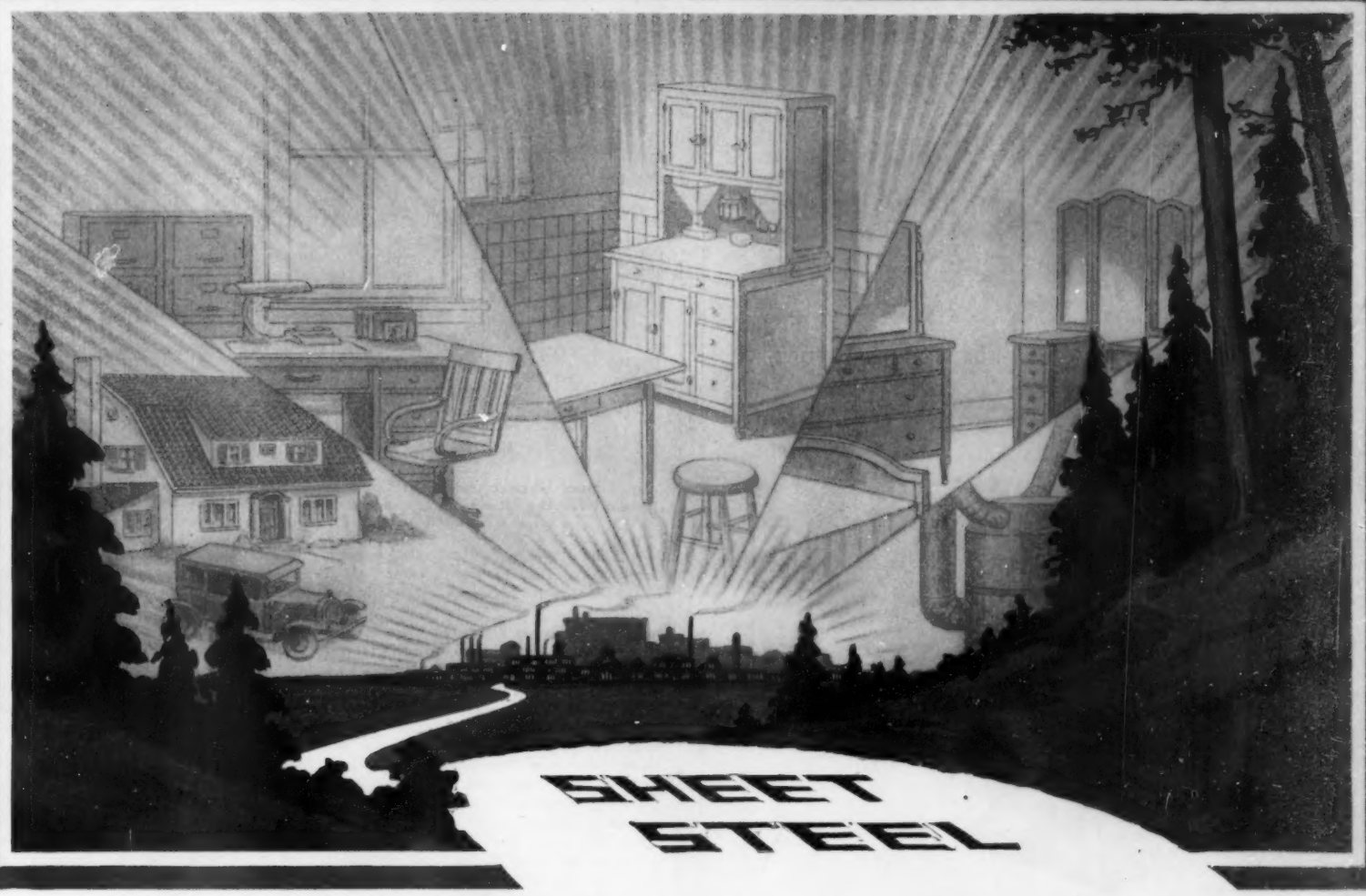


Diagram showing how the blades of the windmill are attached. M. La Cierva spent several years working out this arrangement

Wherein lies the fundamental advantage of the Autogiro? In the fact that with an ordinary airplane, the lift of the wings is dependent on the forward velocity alone. If the airplane is moving forward very slowly, the lift becomes too small to sustain flight. In the Autogiro, the speed of the resultant wind on the blades is compounded of the forward velocity, *plus* the rotational velocity. Therefore, the craft as a whole is capable of moving very slowly while the blades are rotating rapidly and giving a large lift accordingly. The Autogiro is, therefore, capa-

(Continued on page 50)



A Main Road to Better Products and New Markets

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ble of flight with a forward velocity much smaller than that of the airplane, which fact has obvious advantages in getting-off and landing.

Before starting a flight, the vanes are set in motion by hand. A cord is wrapped round four pegs—one on each vane—and pulled by men on the ground. Otherwise the vanes would take too long a time to accelerate. This expedient is only one that would be employed in an experimental machine; some form of starting gear would be embodied in a normal machine.

Having started the vanes, the engine is opened up and the machine proceeds to roll normally. For a short time nothing seems to happen, but suddenly the vanes noticeably fold a little upwards, their speed of rotation increases and the machine seems to jump into the air some five or six feet. Thereafter, it behaves very much like an ordinary airplane. If the tail is held down it climbs; with the fuselage horizontal it flies horizontally and, if the nose is pushed down, it descends. With the engine off, it will glide down at very much the same sort of angle as an airplane. It turns well and shows no sign of swinging on a turn.

But, if the tail is held down at an angle approximating to the stalling angle of an ordinary airplane, the Autogiro keeps the air at a very small forward speed, estimated at 20 miles per hour. If the engine is cut off and the tail is depressed still more, the Autogiro descends on a very steep path only 30 degrees away from the vertical, and yet has a downward velocity of only two feet per second, and a very slow forward speed. Accordingly, not only does the Autogiro land in a very small space, but it rolls not more than 30 feet after touching the ground. Conversely, it can get off the ground very quickly and climb on a steep angle.

Therefore, while the Autogiro does not realize the requirements of an ideal helicopter by rising and descending vertically and hovering, it comes close to achieving these requirements. Even though the fuselage did smash up on the last trial by Frank Courtney, the British pilot, the Autogiro has possibilities as regards safety and the ability to utilize a very restricted space for both get-away and landing. The present Autogiro has a speed of 68 miles per hour, but the inventor claims that with suitable design very great speed can be attained. It is too early to prognosticate what the efficiency of the craft will be, and it is certainly a disadvantage to have to rely on rotating parts for the lift, these can never offer the security of fixed wings, yet the Autogiro's further development will bear watching.

All-Metal Airplanes

HENRY FORD is not only operating an airplane from Detroit to Cleveland and from Detroit to Chicago, but he has purchased the Stout Metal Airplane Company which is responsible for the construction of the planes employed in this service. These planes are built entirely of metal, duralumin; and the views of William B. Stout, their designer, on the subject of all-metal airplanes are, therefore, particularly interesting. Mr. Stout discusses the subject admirably in a paper before the American Society of Mechanical Engineers.

In the design of airplanes, aerodynamic efficiency, lightness of structure, and durability are among the most important objectives. Why are other designers as well as Mr. Stout seeking to replace wood and fabric construction by metal? Not on the score of aerodynamic efficiency. A plane built of wood may have precisely the outward form and aerodynamic characteristics of the all-metal plane. Not on the score of

(Continued on page 52)

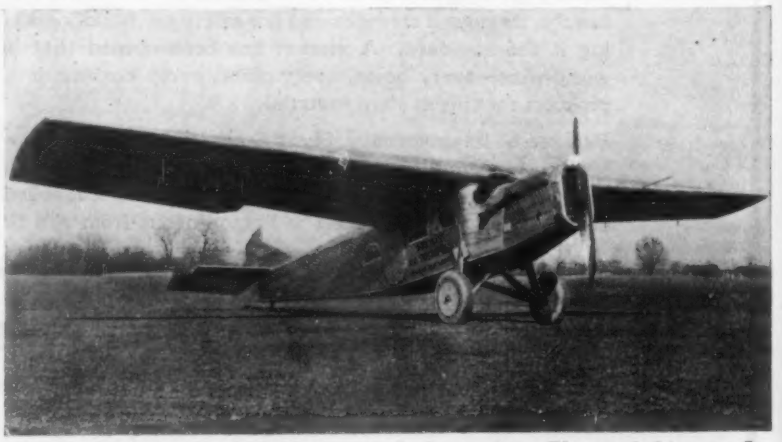

Figure 1. The Stout metal airplane ready for service. Planes of this type fly regularly between Cleveland and Detroit and Chicago and Detroit

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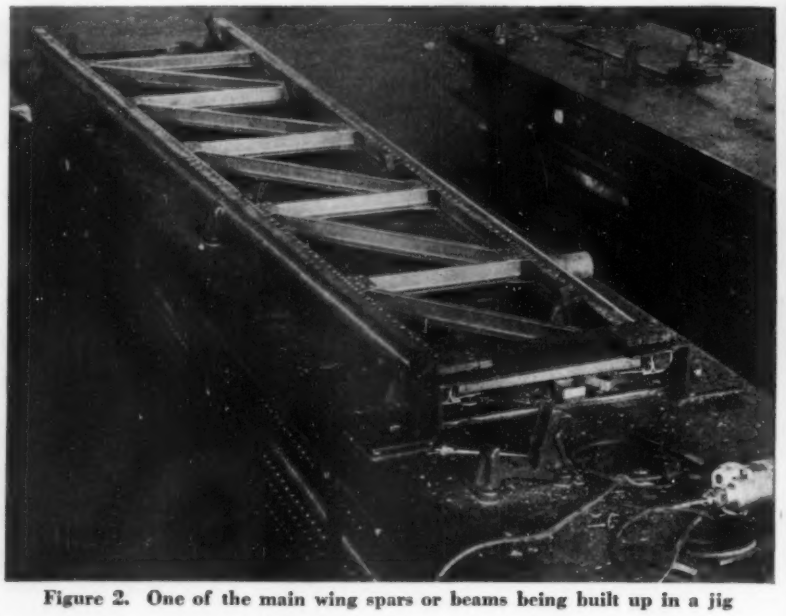

Figure 2. One of the main wing spars or beams being built up in a jig

lightness. Wood, though it is less strong than metal, is also far lighter. One reason why designers are turning to metal, is because metal shows far less variation in strength. One piece of wood may be far better than another, while metal always gives approximately the same characteristics. Hence, a metal structure is far more determinate in its strength. Another reason is that metal construction is far more durable than that of wood and fabric, and renders unnecessary the use of such perishable substances as glue, which can stand neither extreme tropical heat, nor the tremendous cold of the Far North.

The Stout all-metal plane is a splendid example of metal construction and deserves close study.

Figure 1 shows the Stout plane ready for service. It has an internally braced monoplane wing, with no resistance-producing external parts; and it is equipped with that good old stand-by of American aviation, the 400-horsepower Liberty motor, which though it is now surpassed by many modern engines, still maintains its commercial supremacy because of its relative cheapness and because every pilot and mechanic is familiar with its characteristics. It has a wing spread of 58 feet 4 inches, a length of 46 feet 2 inches. Empty, that is without fuel, oil, crew or pay load, it weighs 3,717 pounds. Fully loaded, with pilot, four and a half-hours' fuel capacity, and a commercial pay load of 1,080 pounds, it weighs 5,849 pounds, all told. It has a maximum speed of 115 miles per hour, a cruising or commercial speed of 100 miles per hour and can climb to a "ceiling" of 15,000 feet. The cabin has an enormous cubic capacity for an airplane, namely, 250 cubic feet. It is possible, therefore, to carry eight passengers with their baggage in roomy comfort, or to carry a large number of packages which may be light, yet bulky—for example, a shipment of ladies' hats which may be very light yet require much space.

The commercial pay load is less than a fifth of the total weight of the airplane. In this respect our flying machines are still far inferior to land traveling vehicles. But the plane has heavy air loads and landing loads to meet and it develops a speed far in excess of any other method of transportation, so that even this ratio of pay load to gross load is no mean achievement.

It is of the most refined structural design. The entire structure is of duralumin. This remarkable alloy of aluminum has the strength of ordinary mild steel, when properly heat-treated, but weighs only one-third as much. For the same weight, duralumin is no stronger than modern alloy steel which possesses remarkable strength, running as high as 200,000 pounds per square inch in tensile tests. But owing to its lightness duralumin permits the use of bulkier channels or sections. In the small members of the airplane, alloy steel used to its theoretical strength would become so thin as to have insufficient local strength to stand handling or riveting. Whether duralumin has the same definite character as steel, or whether it resists fatigue as well, are still moot questions; but the majority of designers are of the opinion, and Mr. Stout is among them, that it forms a more promising material for airplane design than steel.

The wing of the airplane is a cantilever structure. It is something like a bridge flying through the air, and its design is

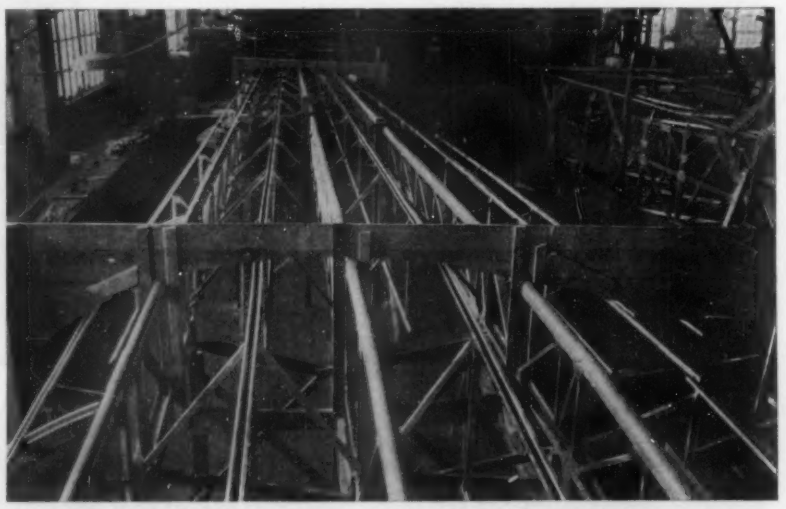

Figure 3. Beginning the construction of the wing. Three main beams or spars are evenly placed inside the wing. Smaller intermediate spars are used as stiffeners to outline the wing contour in between

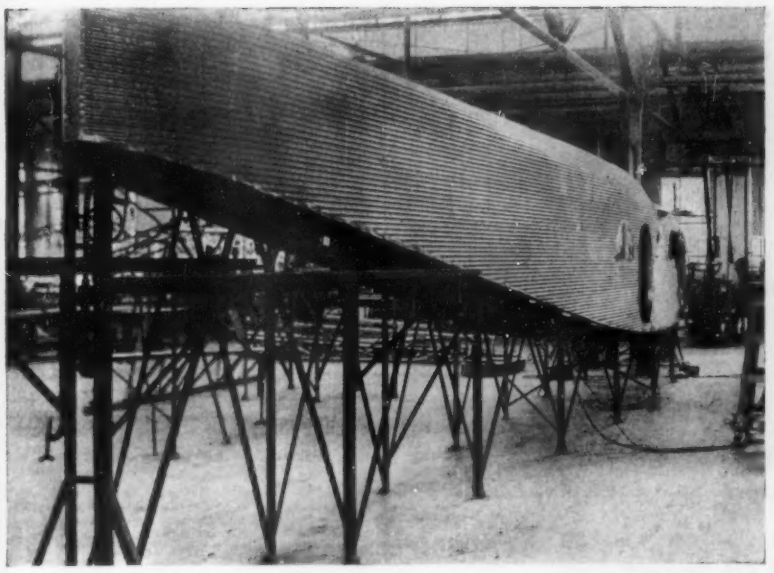

Figure 4. Fuselage being assembled on permanent metal jigs

similar to that of a bridge. Figures 2 and 3 show the internal construction of the wing. There are three main spars or beams inside the surface, 32 inches deep at the center where the fuselage or body fastens on, tapering out to comparatively few inches at the tip where there is much less bending load to be resisted. These beams or spars are evenly placed inside the wings; intermediate or former spars, as shown in Figure 3 are used as stiffeners to outline the wing contour in between. When the main spars and the intermediate former spars are in place, corrugated metal, rolled to fit the wing curve, is riveted to the spars top and bottom. In this way, some designers claim that the skin becomes a part of the structure so that the actual surfacing of the plane is obtained for almost no weight, since it is performing the double function of surfacing *and* structure. The metal skin, instead of being a liability to the structure as in cloth and wood types, may then be considered a definite structural asset. Other designers are of the opinion that the skin adds nothing to the strength and is a very heavy item to carry through the air. This divergence of opinion is far from being ended, but there is this to be said for the metal covering—that it preserves the aerodynamic contour of the wing and prevents flutter of the monoplane wing. The whole wing becomes a rigid box, resisting torsion effectively as the resultant air load travels along the wing chord with varying flight attitudes. Much research and great expenditure of money have gone into the development of the main spars themselves. These spars are shown clearly in Figures 2 and 3. The spar consists of flange or "chord" members top and bottom, with intermediate vertical and diagonal "web" members—very similar to some types of built-up bridge members. The flanges or "chord" members consist of a semi-circular rolled section, 1, riveted to a channel section. 2. The advantages of this semi-circular section are that it is easy to make and that the skin or outer surfacing can be riveted to the chord at any angle without extra fittings. The channel section below, shown at 2, gives side walls to which the web members can be riveted. The wings are continuous across the body or fuselage of the airplane and are fastened to it by six large bolts of great strength, giving a strong yet readily removable connection.

The fuselage, the cabin and some portions of the wings are further illustrated in Figures 4, 5 and 6. The fuselage is more particularly illustrated in Figure 4. It is built up on a jig arranged with a series of cross bulkheads riveted up from duralumin channel sections. These sections are bent up in an ordinary tinners' brake and the entire set of bulkheads can be made by four men within two days, even with the simple equipment used. As the structure of the fuselage goes back of the cabin, the load is carried entirely by the corrugated skin itself, with stiffening bulkheads at intervals. Some of the fuselage channels are shown in Figure 5. In Figure 6 looking through the door into the cabin, we see the interior seats with their upholstery.

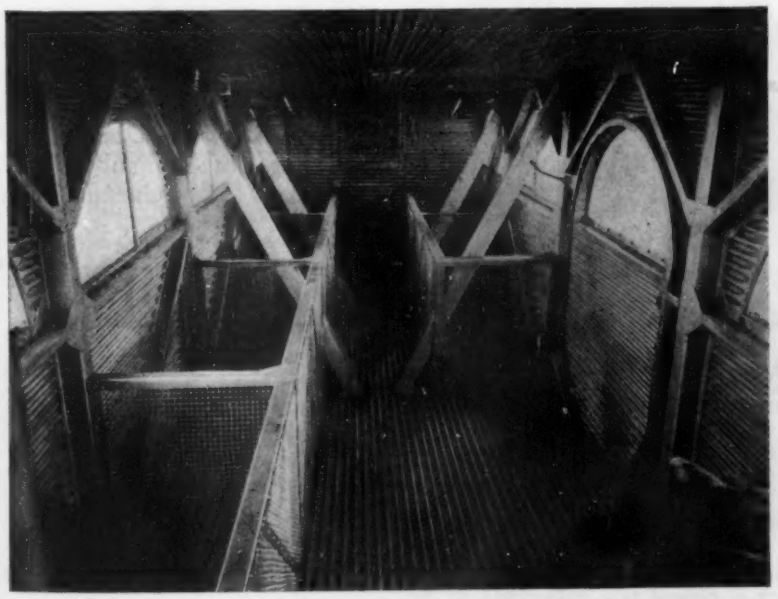

Figure 5. Interior of the fuselage when the plane is used as a freight carrier

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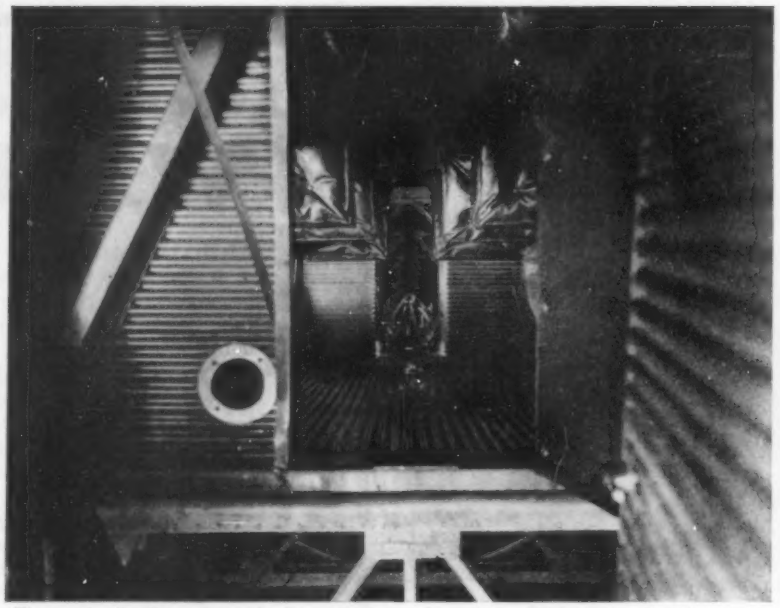


Figure 6. Looking towards the rear from the cabin. This shows details of the wing construction above, arrangement of the cabin, and the bulkheads of the tail structure, as seen from the rear door

A similar all-metal construction is employed for engine mounting, control surfaces and all other parts of the plane.

There are innumerable problems to be solved in the metal construction of a plane: how to make the metal covering of the wings really take a fair share of the load; how to cheapen and make more rapid the process of putting in the innumerable rivets required; how to make it quite certain that the rivets will stand up and not produce local cracks and failures under severe vibration as in the engine mounting; how to cheapen the construction by using standardized sections throughout. These problems will continue to call for the attention of designers and inventors alike. Enough has been said to show that the art of all-metal construction has already reached a stage where it is useful and practical.

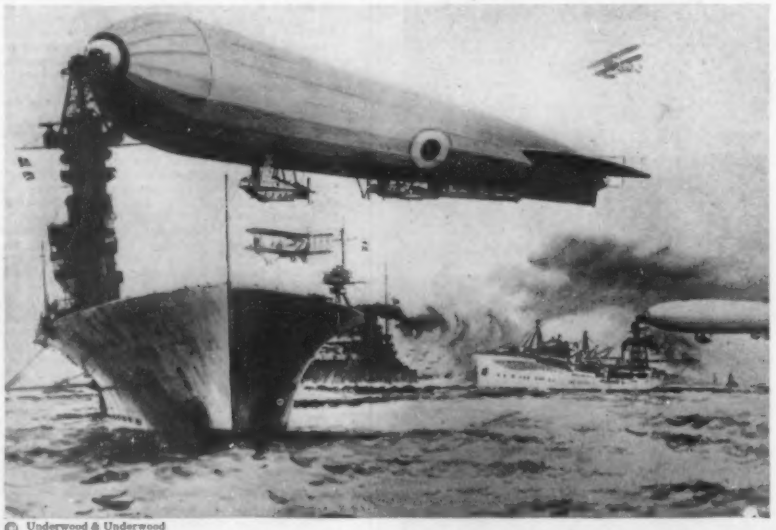
Naval Aviation

EVERY midshipman at Annapolis must now study aviation, and the United States Naval Institute has produced a splendid little book under the above title to meet the students' needs. It is far more than a class text, however—its author, Lieutenant W. W. Warlick, can prophesy and thrill as well as instruct. What more startling, and yet more reasonable than the frontispiece, which we are allowed to reproduce herewith?

Here we have a huge aircraft carrier, with broad deck for the landing of navy planes. To one side of the deck is a huge mooring mast, with an airship swinging freely at its top—perhaps the reader will improve even on this picture by imagining the airship itself as a plane carrier with small craft suspended from its keel. Even then, the picture would not be too fantastic (the *Langley* aircraft carrier, the former tender *Patoka*, with its mast to which the *Shenandoah* was so often moored, and the Army Air Service experiments in hooking small planes on to an airship in flight will be readily recalled by our readers).

At present the most important functions of the naval airplane are auxiliary; they are scouting and spotting. Successful bombing and torpedoing of capital ships may come soon. Here is a suggestion for another and more terrifying form of bombing: "The whole supply of air for the modern ship is taken from the upper decks and forced by blowers to every compartment and corner. Imagine the effect of a salvo of asphyxiating bombs." International convention prohibits this method of dealing death, but who can tell what may happen in bitter warfare?

An airplane can make a get-away in a hundred and fifty feet and with arresting gear may come to rest after alighting in even a shorter distance. Why then the prodigiously long flush decks of the *Langley?* Why not make part of the deck flush and utilize the rest of it for masts, smokestacks, heavy deck guns? Because without a flush deck, the obstructions to the air flow produce unpleasant eddies which may have a disastrous effect on a plane about



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An imaginary photo-sketch picturing an air base at sea, an almost immediate possibility. At the left a huge dirigible is seen moored to a plane carrier of the type used by England. At the right, one is moored to a mother-ship on the type of the *Potoka*

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Polar Pastures

In the January FORUM, Vilhjalmur Stefansson reveals unexploited sources of food which will keep alive many more millions of people than exist on the earth today.

This article is the latest contribution to the FORUM's survey of the economic, biological, and racial factors which must inevitably determine whether the nations of the world shall be in a state of war or peace.

In the same issue: *Dean William Ralph Inge,* of St. Paul's, *G. K. Chesterton, Philip Guedalla, Rose Macaulay.*

FORUM

JANUARY

Edited by
HENRY GODDARD LEACH

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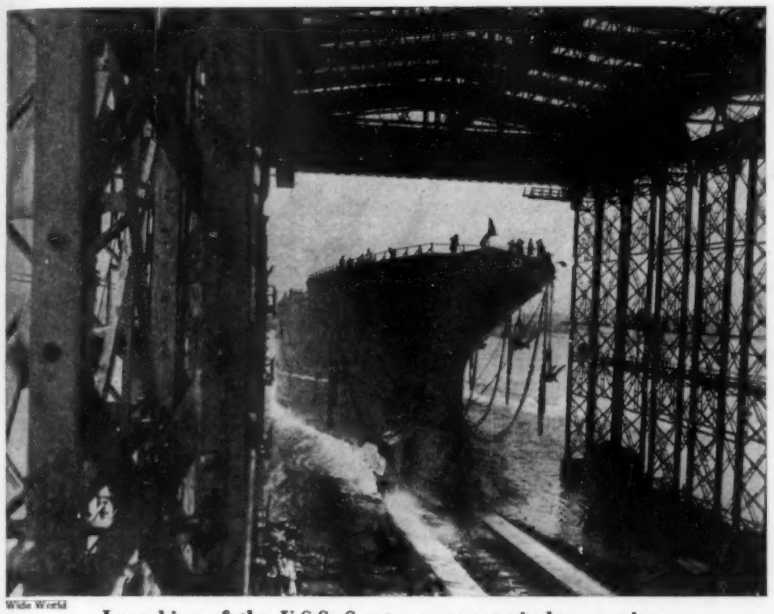


Wide World

Launching of the *U.S.S. Saratoga*, newest airplane carrier

to alight slowly and, therefore, under poor lateral control. With air disturbances, the plane may be set down suddenly and thus break its landing gear; it may suddenly rise and then flop down; or it may be struck by a cross gust and be blown over the edge of the deck. Accordingly when the *Langley* is rigged for flying, there is nothing above the deck, the boat stowage is all below and the smoke is let out at the side.

The new aircraft carriers such as the *Saratoga* and the *Lexington* are not entirely flush, but have an island on the starboard side to include the stacks, mast, bridges, fire control towers, and so on. In such a case the nose of the carrier is headed off the wind a few degrees and the deck is then almost entirely free from eddies and gusts, except in the immediate vicinity of the island.

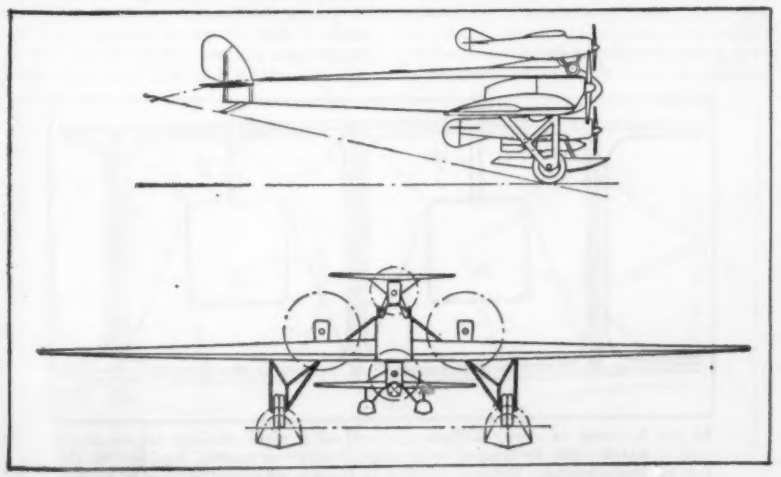
Sometimes naval aircraft on duty with the fleet and lacking the support of aircraft carriers, must work with tenders. The planes alight alongside the tender, are refueled and undergo necessary repairs. A torpedo plane has even been refueled from a destroyer at sea. The fuel was transferred by means of a hose, while the destroyer was rolling approximately twenty degrees.

It is customary to bewail the fact that with the advent of steam, seamanship has disappeared. There should be, if Lieutenant Warlick's description is correct, plenty of opportunity for seamanship in towing a seaplane. This is a most delicate undertaking under any conditions. The pilot of the plane, as soon after landing as possible, rigs a sea-anchor to reduce his rate of drift. The vessel that is to take the plane in tow, steams slowly across its stern, creating an oil slick if necessary. The line is readily picked up as the plane drifts over it. If the towing continues for any length of time, the towing gear is as a rule scarcely strong enough to stand the strain. In towing all movable weights are placed aft, and it may be necessary on large planes for members of the crew to ride on top of the horizontal stabilizers at the tail of the ship! Hoisting a seaplane aboard is a similarly tricky operation, particularly in a rough sea.

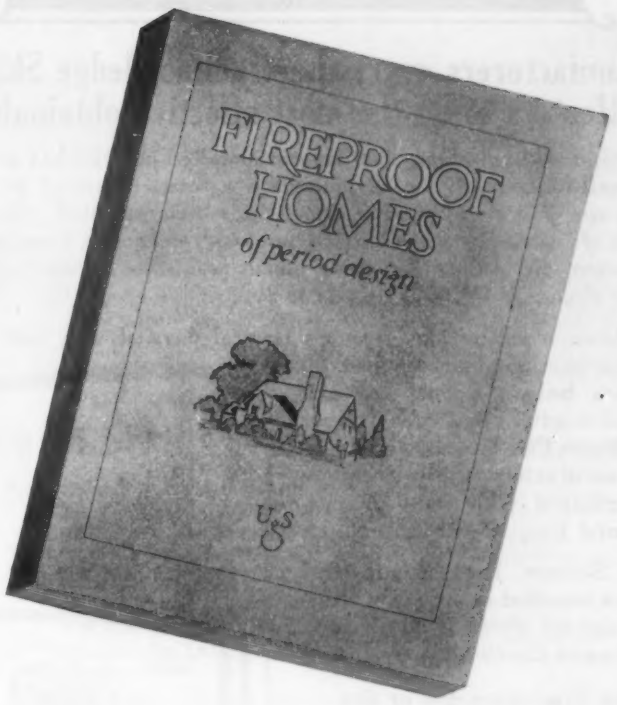
But the midshipmen are not to pay attention to scouting or seamanship alone. They must, if they are to be naval aviators, be endocrinated with the principles of aerial combat. What could be more inspiring than these graphic sentences: "..... Captain Ball the first great British ace, and Captain Guynemer. They knew neither fear nor caution. Fighting alone, by preference, they unfailingly forced combat, impetuously engaging an enemy formation of twenty planes with the same ferocious, smashing attack with which they greeted a single opponent. An enemy sighted was an enemy to be engaged by direct approach, along the shortest line, without regard to position or odds."

A Carrier Airplane

IN a previous issue we have described experiments made by the Army Air Service with an airship to which a small Messenger plane was hooked. Now the suggestion, first made by the Germans of building a carrier airplane is revived by a writer in *Aviation*. On the giant, rather slow, airplane transport would be mounted smaller planes, detachable at will for purposes of defense or bombardment. The large mother ship would give the long range necessary in military operations; the detachable craft would have nearly twice the speed, and thanks also to its smaller size would be less vulnerable to the anti-aircraft fire of surface vessels. The smaller plane could likewise



Suggested arrangement of a carrier airplane



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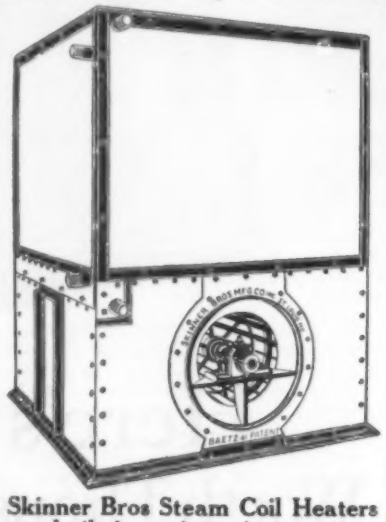

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Atlantic-Photo Co., Berlin
The Aeromobile as an ordinary airplane of the "baby" type

put up a better fight against rapidly maneuvering combat planes. After the completion of a mission the smaller craft might very well return to the mother ship.

The diagrams give a rough suggestion of the arrangement of a carrier airplane. The engineering difficulties should not be insuperable. Nor should the smaller ships be just so much dead weight and parasite resistance to withstand. They could be made aerodynamic units of the whole arrangement, responsible for a certain amount of the lift, and with their propellers working in conjunction with the airscrew of the mother ship.

Saving Helium Gas

IT is not for us to state what the exact cause of the *Shenandoah* disaster was. The stories are too conflicting and the positive evidence too scanty for even the Board of Inquiry to be sure of arriving at correct findings. But it is quite probable that modification of the safety valve systems and the general unwillingness of the crew to valve helium on account of the expensive character of this gas, had something to do with the disaster. Therefore, a recent patent of the Schutte-Lanz Airship Company has a peculiar interest.

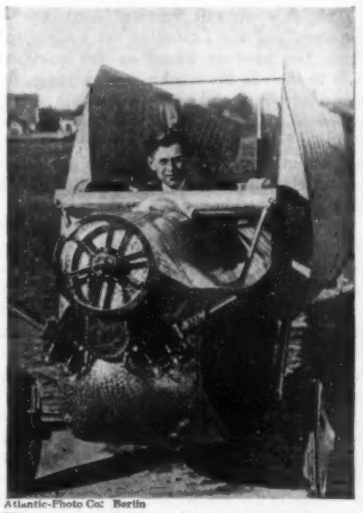
The idea is illustrated in the sketch. In the interior of every helium gas cell of a rigid airship an auxiliary cell *a* filled with hydrogen is provided, with a pipe *g* leading clear to the top of the airship.

An Aeromobile

IT is always tempting for designers and inventors alike to imagine vehicles which can be used as automobiles or airplanes at will. A German engineer, by the name of Maykemper, has built a machine of this type which is at least neat and practical in appearance.

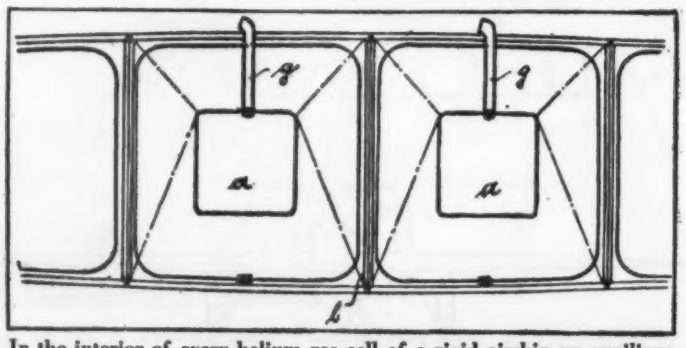
In the first photograph the Aeromobile is seen as a "baby" airplane of clean looking design, with a very low fuselage and the axle going through the bottom part of the fuselage, so that there is a minimum of exposed parts in the landing gear. Equipped with a small motorcycle engine, the little airplane weighs only 770 pounds with pilot and fuel for five hours flight.

In the second photograph, the loosening of a few pins has allowed the two outboard parts of the wing to be swung into a vertical position and then to be folded up against the sides of the fuselage. The craft is now functioning as an automobile which is only five feet in width and under twenty feet in length.



Atlantic-Photo Co. Berlin
The Aeromobile with its outboard wing sections swung vertically and back and the propeller removed so that it can travel the roads like an automobile

There is no reason to doubt the successful functioning of the Aeromobile in its dual capacity, but it would be interesting to know how the mechanical problem of transmitting power to the wheels in rolling on the ground has been met without prohibitive weight. Also it would appear from the photographs that the tail of the machine is provided with a tail skid and not a third



In the interior of every helium gas cell of a rigid airship an auxiliary cell *a* filled with hydrogen is provided with an outlet leading to the top of the airship. Danger of fire is largely eliminated and hydrogen instead of helium is lost in maneuvering

Curious Geometrical Figures Appearing Upon Mars

From Prof. W. H. Pickering of Jamaica, British West Indies, comes the following interesting item:

It is a rather curious coincidence that at each of the recent very near approaches of the earth to Mars, strikingly regular, although only temporary, geometrical figures should have appeared upon its surface. The well-known cross, centered in the approximate circle of Hellas, appeared to Schiaparelli in 1879. (Figure 1.) It may have appeared in the unusually close apparition of 1877, but in that year he saw only the circle and the single vertical canal. The diameter of the circle is 900 miles. The cross has of late years been replaced by an irregular curved structure.

The next very close approach of our planet occurred in 1892. In that year a regular pentagon with central radiating canals was seen in Arequipa (Figure 2.) One of the canals was missing, but it may have been too delicate for our 13-inch telescope, or it may have been covered by a temporary Martian cloud when we made our drawing. The center of the pentagon was located at Ascraeus Lake, as it is now called, although then unnamed, and the diameter of the figure was 800 miles.

In the year 1909 no very complicated figure seems to have been seen. The Lowell Observatory published no special report on that apparition, as they had done for some of the earlier years. M. Jarry-Deloges on September 26 drew Figure 3, which is perhaps more interesting than striking, because large four-sided figures are most unusual upon Mars. The central meridianal canal is Laestrigon, the two lower ones Tartarus and Cerberus. The horizontal one, Aesculapius, has become more prominent of late years than formerly, while the two upper ones are rarely seen, but both have been confirmed by later observers. The length of Laestrigon is 1,200 miles. *(Observations des Surfaces Planétaires, 2, Plate 9.)*

At the apparition of 1924 the earth passed closer to Mars than had been the case for over a century, and closer than will be the case again for a century more. This year an unusually large and complicated figure appeared. Again it was pentagonal, apparently a favorite figure with the supposed Martians, but in a still different place. The pentagon of Elysium, which later changed into a circle, is of course well known to all students of the planet. It measures 800 miles in diameter, but this one is much larger, measuring approximately double the size. Moreover it is not a true pentagon, although of that nature, but a five-pointed star with symmetrical appendages attached. (See Figure 4.) Obviously so large a figure, formed on a spherical surface, can only appear symmetrical in one particular position of the planet. That position happened to be assumed by the earth this past year at opposition, when the planet was nearest to us, and the center of the disk in Martian latitude 16° S. Again, to see it properly, the central meridian must be at longitude 0°. Dr. Trumpler of the Lick Observatory made the original drawing showing the canals from which this figure is constructed, but as shown by him it is not quite symmetrical, because the drawing was not made with the proper central meridian for that purpose. Still, even as he drew it, it is rather striking. *(Pub. Astron. Soc. of the Pacific,* 1924, 36, 266.)

Some of the canals which compose it are well known, and were discovered by Schiaparelli, namely Typhonius, Orontes, Phison, Euphrates, Hiddekel, and Protonilus. The others were discovered and named by Lowell. Indeed he saw all the canals forming the figure, but he saw also many others crossing it, that confused and concealed it. He represented it moreover not as seen in the sky, but on Mercator's projection, consequently no one would ever detect from his drawing its symmetrical character. At this apparition it stands out plainly and alone in Dr. Trumpler's drawing, in what may perhaps be described, on account of its surroundings and framing, as the most conspicuous possible position upon the planet. As above noted, it is in only one position, that occupied by the earth at the last opposition, that the star appears to be symmetrical, for it really is not symmetrical at all as laid out on the surface of the planet itself. And if it had been symmetrically laid out, unless it had been located at the very center of the disk, it is most unlikely that we should have happened to recognize its symmetrical character.

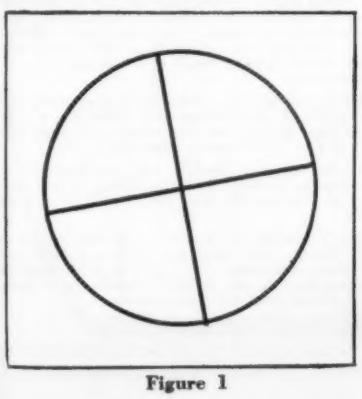


Figure 1

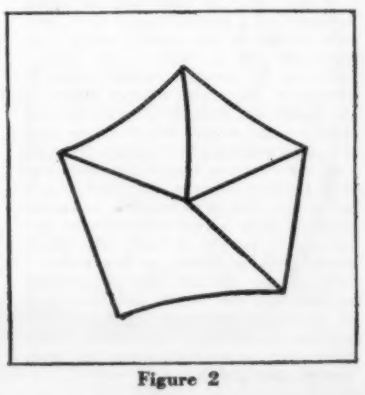
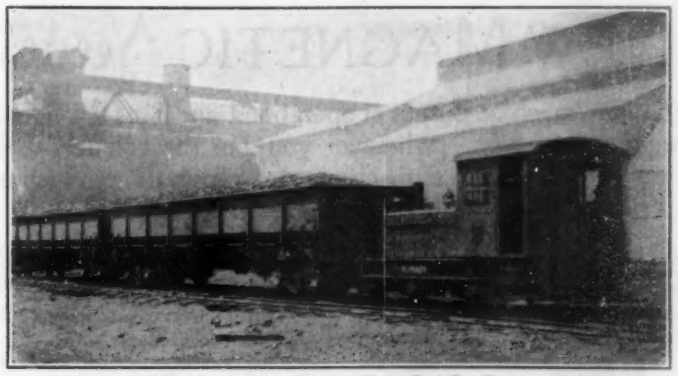


Figure 2



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It is indeed curious that these complicated figures should occur on Mars, and still more curious that they should all be only temporary, and should appear only at the very close apparitions of the planet, while at other apparitions the numerous other canals should present no symmetrical structures. There is of course a definite system to their customary arrangement that we are now gradually beginning to understand, and as above noted, the avoidance of large

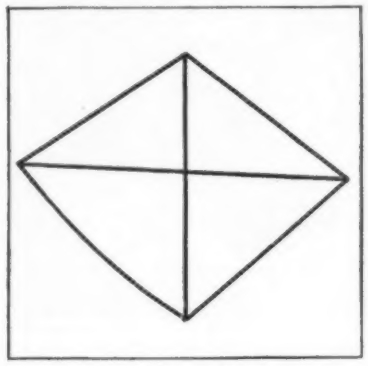

Figure 3

four-sided figures among them is of itself curious. Some people will doubtless believe that these designs are not due to mere accident, but are artificial, and constructed for our especial edification, and as an announcement of the existence of intelligent life on their planet. If so, we wish the Martians would plant them out, or otherwise construct them, more frequently than once in every fifteen and a half years. If not due in the past to chance, we wonder very much what figure will appear at the next close opposition in 1939. However we must not expect too much

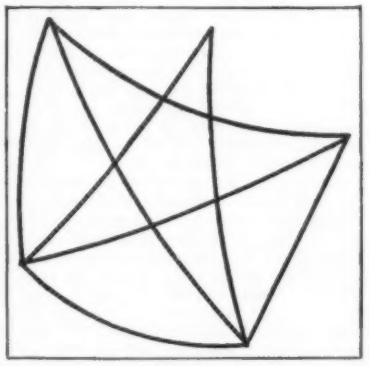

Figure 4

of the Martians, and if they have been doing this sort of thing for the last 10,000 years or more, we must consider them to be far more persevering in their endeavors to communicate, than the inhabitants of our own self-satisfied, and very unresponsive planet.

William H. Pickering.

Useful Star-gazing

Although you may never have the adventurous experience of being set adrift in a lifeboat or being lost among the clouds, nevertheless, we think you will enjoy this description by Elmer B. Collins, Nautical Expert of the Navy Department, of the "Clock in the Sky."

If you were to blind-fold an expert navigator of a modern ocean liner, ship him to any of the world's seven seas, transport him to any of the various points of the compass, either in the direction of the warm tropical waters of the South Sea Isles, or towards the cold stormy seas of the frigid zones, and, then after removing the bandage from his eyes, you were to supply him with nautical almanac, sextant, and chronometer, set to the time of Greenwich, in twenty minutes, after he has observed the altitude of a couple of stars, his whereabouts will be known to him within a mile or so. Is not this an amazing triumph for the worth and usefulness of practical astronomy? Surely the movements of these numerous cosmic bodies are for other purposes than sentimental star gazing.

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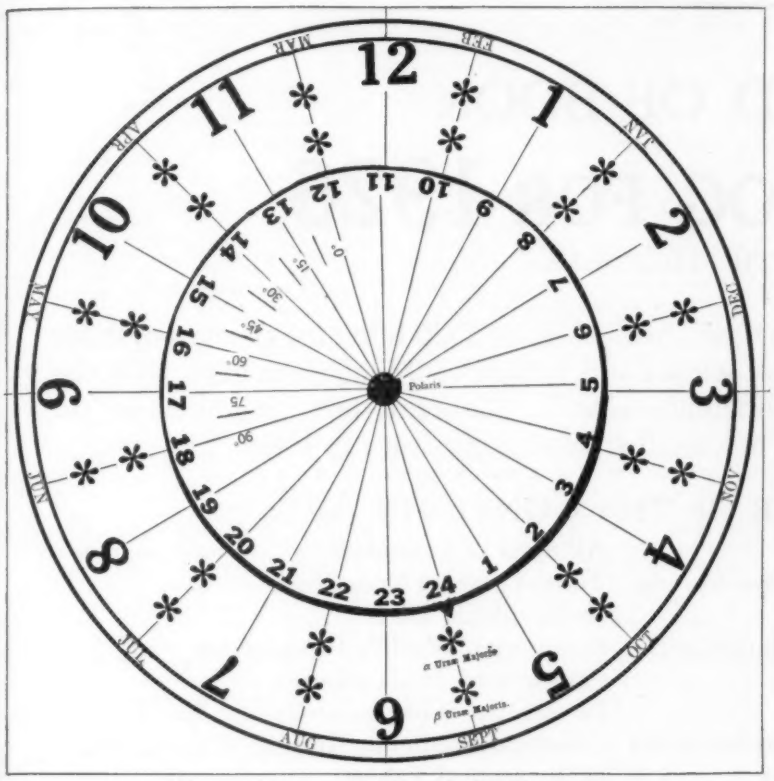


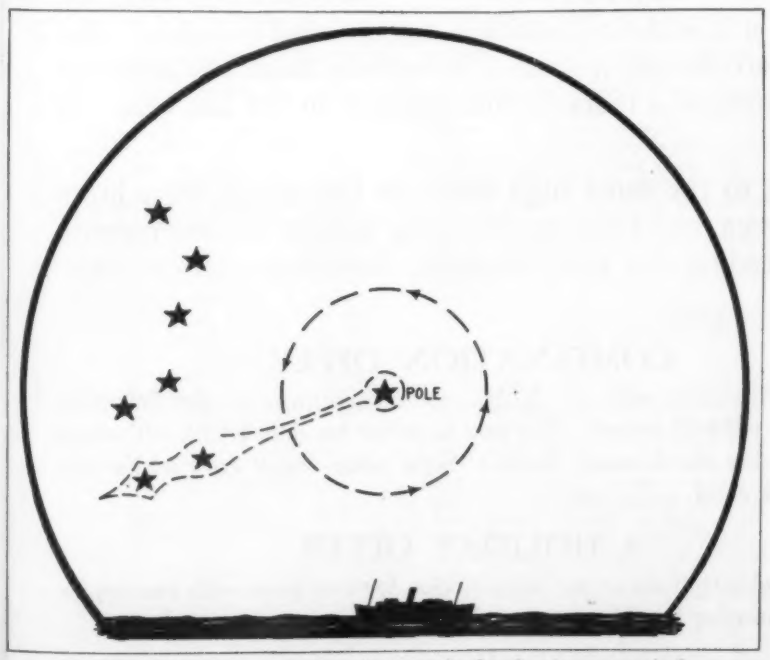
How to learn to tell time by the Big Dipper

A more serious predicament would confront this self-same navigator were he suddenly called in the night to abandon ship and take charge of a lifeboat. Having now neither chart, almanac, nor sextant, his skill and previous knowledge of the movements of moon, planets, or stars would reveal nothing as to the whereabouts of the drifting lifeboat. If this navigator were aware of a simple means to interpret the message as told by the clock in the sky he or anyone might be informed of their positions on this spherical earth of ours. There is a clock in the sky, visible on any clear night, or at times through a break in the clouds. It tells the time of the night from which is obtained the longitude; it informs of the true latitude.

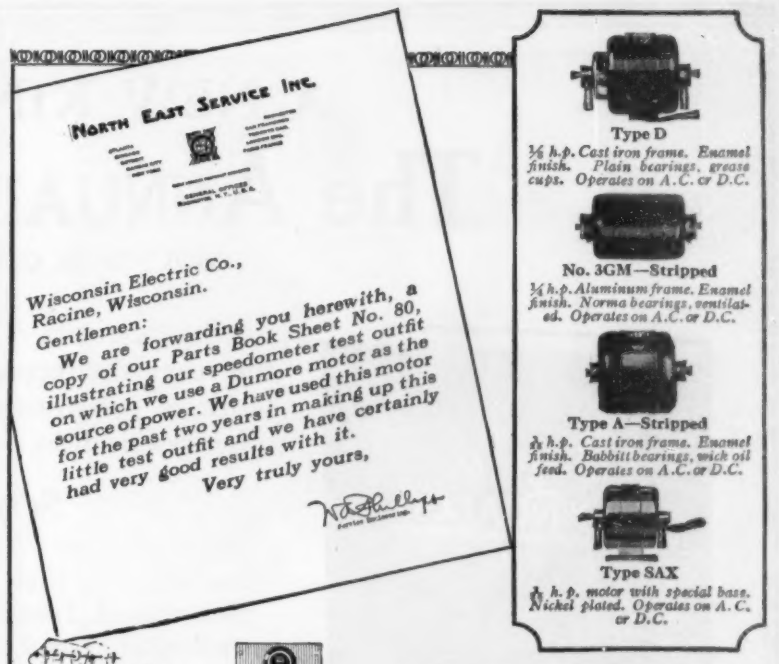
Everyone has gazed into the heavens at night and observed the Big Dipper with its ever-faithful Pointers indicating the position of the North Star or Polaris. The hour hand of the sky clock is composed of this North Star and the two Pointers. The center of the revolving hand is the North Star. This hand moves counter-clockwise over the face of the sky clock at a rate of one-half that of the hour hand of an ordinary timepiece. The hour mark of twelve on the sky dial is above, and the six-hour mark below, similar to any ordinary time clock. On any night this hour hand can be read in the sky and the hour readily estimated; the hand is vertical at the hour of three and nine. The time we are noting in the heavens is star time; and we desire sun or watch time. Therefore, the reading of the hand does not give directly the time of the night. With a piece of cardboard, marked as illustrated, the difficulty is solved.

The position of the clock hand in the sky is shown for the 22d day of each month at midnight or 24 hours. Remember also that the clock hand continually moves counter clockwise about the North Star once in 24 hours. Take cardboard and plot the stars as shown in the illustration. Select another cardboard and divide into 24 hours. Now cut in the form of a circle, first laying off in one quadrant 0° 15° 30°, and so on, to 90° showing angular arc 7½° apart. Bind the cards together at the

(Continued on page 61)



The Big Dipper's two "pointers" form the hands of a great clock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h.p. motor with special base. Nickel plated. Operates on A.C. or D.C.

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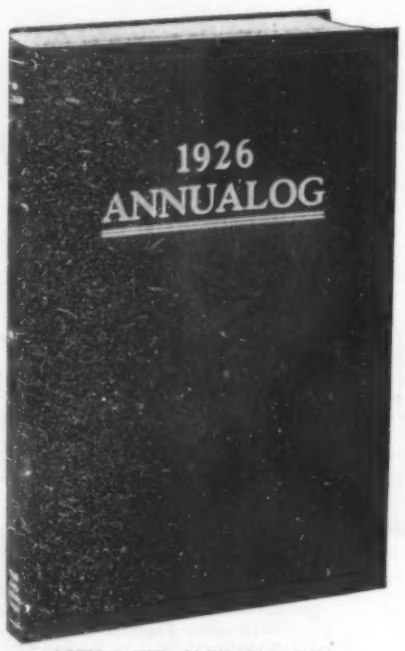

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Its development is continuing. While holding to the same high ideals as heretofore, its editors aim to make it the most interesting magazine in America, and they are preparing articles for the coming year you cannot afford to miss. You will enjoy reading the new Scientific American every month. Better make sure of getting it by subscribing now.

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center with a pin or thumbtack so that the inner wheel will revolve. The center pin is the Pole or North Star. On the date in which the latitude and longitude is sought set the 24 hour of the inner wheel on the Pointers of the month. Now read the hour hand of the clock in the sky.

Suppose that on the night of September 22d our navigator in the drifting boat has his watch set to Greenwich time as is the usual custom. Let him note the hour in the sky, say seven o'clock. Set the inner wheel with 24 on Pointers at September, now follow the inner wheel to where the hour coincides with seven o'clock on the outer or sky dial and the time noted is 21 hours or 9:00 P.M. sun time or watch time of that date. Compare this time to the watch in pocket set to Greenwich time. Say, for illustration, the watch read 11:00 P.M. Then the difference between 9:00 P.M. and 11:00 P.M. is two hours. Since a difference of one hour in time is an arc of 15° of longitude, the longitude found here is 30° West. Applying the precepts of an old sea jingle which runs, "Greenwich time best, longitude west, Greenwich time least, longitude east," we really determine the proper hemisphere. Since in the above case the Greenwich time is best or greater, the longitude is west.

Now for the latitude, look again for the clock in the sky. This time look only at its center or North Star and bearing in mind the old elementary fact of astronomy that the latitude of any place is always equal to the altitude in the heavens of the North Star, set the degree mark on the horizon at 0°, sight at the North Star and read as closely as possible its altitude, say 37½°. The navigator now knows he floats in about 37½° north 30° west.

He has determined a close approximation to the real truth of his whereabouts, much more so than would be possible by random conjecture. Without tools, science is of no avail in our dilemma. With the aid of a simple piece of cardboard and the clock in the sky the locality of the drifting boat is found. Perhaps some daring aviator blown far off his course by gales of wind and lost among the clouds may avail himself of what the clock in the sky tells.

Elmer B. Collins.

Where Credit is Due

Two very interesting letters have come to us as a result of our item on helium air in the July issue. We think our readers should be apprised of the facts concerning the origin of the idea that helium air would be useful for submarine divers. It is our pleasure to present this information:

Dear Sir:

I notice in your Scientific American Digest, conducted by Mr. Albert G. Ingalls, on page 52 of your issue of July, 1925, that "helium air" for submarine divers is mentioned as a possibility, and the results of experiments made by the Bureau of Mines Scientific Corps confirm it.

It may be of interest to your readers for me to note that I made this suggestion more than five years ago, and attempted to secure from the Bureau of Mines a supply of helium for experimentation in this direction, but without success at that time. I communicated this idea to Prof. J. C. McLennan, of the University of Toronto, who had inquired of me suggestions as to possible uses for helium. My reasoning in the case has been shown to be correct by the experiments described. It is only proper that the public should be informed as to the origin of these ideas. Copies of the letters concerning this matter are herewith transmitted.

Elihu Thomson.

Director of the Thomson Laboratory of the General Electric Company.

West Lynn, Mass., Aug. 25, 1919.

Bureau of Mines, Washington, D. C.

Dear Sir:

I am writing for information as to the actual status of the recovery of helium in quantity from natural gas. We have seen so many published statements in regard to this matter which were somewhat difficult to believe that I am appealing to headquarters for such information as may be available as I have in mind a possible use for helium by which experimentation would have to be carried out before settling its adaptability to the purpose I have in view.

Very truly yours,

(Signed) Elihu Thomson.

January 14, 1920.

Mr. J. C. McLennan, Prof. of Physics, University of Toronto, Canada.

Dear Sir:

I notice in the issue of *Chemical News*, December 19, 1919, under a note entitled "Helium" it is stated that you have been interested in finding uses for helium outside of balloon inflation. This prompts me to write you saying that I had communicated with our Bureau of Mines in relation to a use for helium based on the idea that after the war there would be a considerable stock of the gas on hand which could be obtained for distribution, if desired. I found that this was not, indeed, the fact; and practically no pure helium (or nearly pure helium) had been produced from the Oklahoma or Texas gas, as I had been given to understand had been done from the various publications. My idea in relation to the matter is on account of its very high diffusive power, as compared with nitrogen, it might be possible to make a mixture of helium and oxygen to be supplied to divers or others working under high pressure, the amount of oxygen being determined by experiments, which, when mixed with helium, should allow respiration and much greater freedom in the removal of effete gases from the lungs, the gas interchanged and speeded up from two to three times. Only experiments could determine the value of this suggestion, if it has any; and, of course, it is based on being able to obtain helium fairly free from admixtures and in sufficient quantity to be supplied to a diver. Inasmuch as salvage and caisson work is limited at present to perhaps about 150 feet or a little more, it is thought that by substituting helium for nitrogen in the air breathed this depth might be, say, increased 50 percent or more.

Very truly yours,

(Signed) Elihu Thomson.

Telescopes

Judging from the enthusiasm for telescope making, evidenced by the letters received in response to our November article, star gazing is going to be the pet pastime for hundreds of Scientific American readers. Mr. R. E. Wicker of Pinehurst, North Carolina, puts in his bid for more information on the subject, presents us with a bouquet, and then winds up with a threatening postscript.

Editor, Scientific American:

In your November issue you have an article dealing with the telescopes of home manufacture. By all means let us have the other article mentioned. After whetting the appetite of your readers with the first article, I do not believe you are mean enough to withhold the second, even for a short while.

Years ago, there lived in the backwoods of Cape Fear River a man famed in North and South Carolina as a millwright. His schooling must have been meager, but it is told that he put to shame, by his superior natural wit, an expert sent out by the Leffel people to install a pair of wheels in a South Carolina cotton mill.

People who knew him admired his ability and wondered where he got his knowledge.

A few years ago (sometime after his death) the writer visited his home in search of some documents concerning the sojourn of the Scottish heroine, Flora MacDonald, in the Cape Fear section, and upon opening his old chest of papers, brought to light a complete file of the Scientific American of Civil War vintage. I made no note of the dates, but recall one which explained the mechanism of the "New" Springfield rifle, with half page illustrations. Of course, I understood immediately where he obtained his wisdom!

Very truly yours,

R. E. Wicker, C. E.

P.S.—Don't delay that article!

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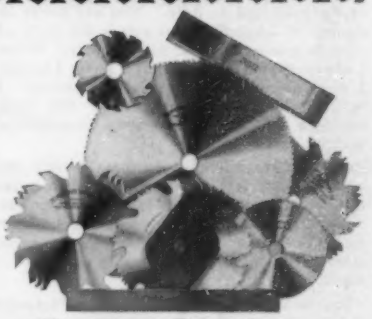

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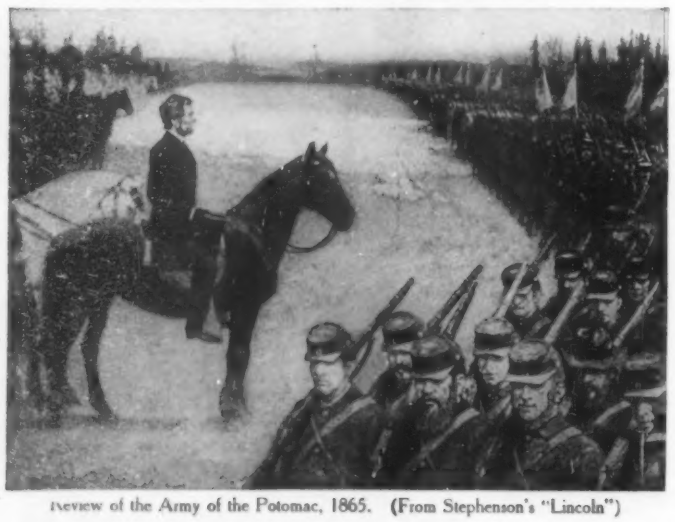

Review of the Army of the Potomac, 1865. (From Stephenson's "Lincoln")

"THE President was never in a firmer, more self-contained mood than on the last night of the session" (March 3, 1865). "He was in his room at the Capitol signing the last minute bills. Stanton was with him. On receiving a telegram from Grant, the Secretary handed it to the President. Grant reported that Lee had proposed a conference for the purpose of a 'satisfactory adjustment of the present unhappy difficulties by means of a military convention.'

"Without asking for the Secretary's opinion, Lincoln wrote out a reply which he directed him to sign and despatch immediately.

"'The President directs me to say that he wishes you to have no conference with General Lee, unless it be for the capitulation of General Lee's army, or on some minor or purely military matter. He instructs me to say that you are not to decide, discuss, or confer on any political questions, such questions the President holds in his own hands and will submit them to no military conferences or conventions. Meanwhile, you are to press to the utmost your military advantages.'

"In the second inaugural delivered the next day, there is not the faintest shadow of anxiety. It breathes a lofty confidence as if his soul was gazing meditatively downward upon life, and upon his own work, from a secure height.

"The world has shown a sound instinct in fixing upon one expression, 'with malice toward none, with charity for all,' as the key-note of the final Lincoln. These words form the opening line of that paragraph of unsurpassable prose in which the second inaugural culminates:

"'With malice toward none; with charity for all; with firmness in the right as God gives us to see the right, let us strive on to finish the work we are in; to bind up the nation's wounds; to care for him who shall have borne the battle, and for his widow and his orphan — to do all which may achieve and cherish a just and lasting peace among ourselves, and with all nations.'"

—From STEPHENSON'S "LINCOLN."

"The Best American Biography Produced to Date"

When a great and discriminating book store such as Brentano's in New York City issues a notice like the following, you may be sure that it marks a notable event in the history of authorship and book publishing. On a little card widely distributed by that house is printed: "We recommend LINCOLN, by Nathaniel Wright Stephenson, as one of the best American biographies of the last ten years."

And Professor Roy Franklin Nichols, of the Department of History at Columbia University, goes even further. He says: "In my opinion, it is one of the best, or perhaps more accurately, the best American biography produced to date. You are never in danger of forgetting that this is the story of Lincoln's inner as well as outer life. When I closed the book I felt that I knew Lincoln. I have never had the privilege before. I believe that the publication of this book begins a new era of American biographical writing."

But Professor Nichols's estimate is only one item in a perfect avalanche of commendation from historical scholars of recognized authority, from prominent writers, from journals whose book notices carry great weight—and all of a favorable tone that is extraordinary.

"The most satisfactory life," says Professor Allen Johnson, of Yale; "Deserves unqualified praise," says the New York Herald Tribune; "Brilliant," says Senator Albert J. Beveridge; "The most brilliant life of Lincoln ever written," says Joseph Lawton Newton, editor of the Christian Century; "Marvelous," says Frederick E. Taylor, President of the Northern Baptist Convention (referring especially to Stephenson's analysis of the psychology of the great President); "A triumph of imaginative realism," says Stewart B. Sherman; "Fascinating," says the New York Times; "Superb," says Warren P. Hall, Professor of History at Princeton University.

The verdict is almost unanimous! Few books equal it in vivid interest and charm. It is fascinating in its skillful delineation of the gradual development of Lincoln's mind and character and as an illuminating study in personality and springs of action.

In the face of such a wealth of laudation from such sources, it would seem to be a hopeless task here to construct another pæan of praise even with the highest skill in phrase making. This is a story of the development of a man's soul told with the consummate skill of an artist, carrying the reader along at a tension which, as the New York World says, "mounts and mounts into the crashing finale of victory — and the heroe's death."

The book is handsomely bound in dark blue cloth, stamped in gold, printed on heavy book paper, and contains 478 pages. It is strikingly illustrated with portraits and rare prints. The price is $3.

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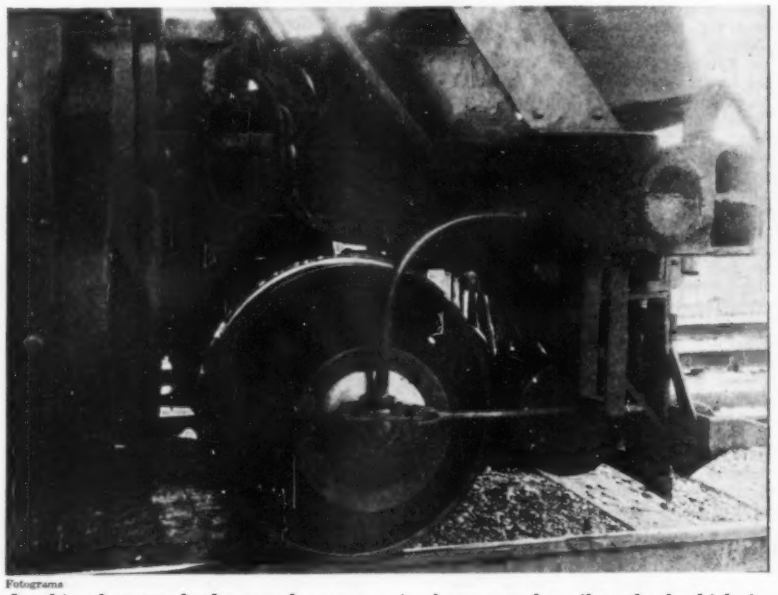
Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



Fotograms

In this photograph the speed governor is shown on the pilot wheel which is coupled with control circuits of the locomotive so that permissive speeds may be incorporated. Radio controlled signal lights on the cab forewarn the engineer of impending danger

Wired Wireless for Train Control

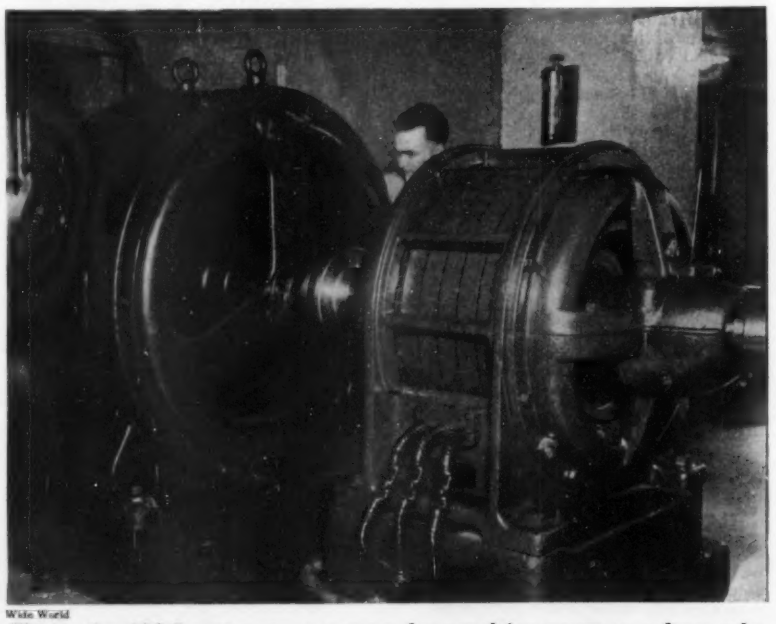
A WIRED wireless system of continuous train control by means of safety devices, operated by the high-frequency currents, has been demonstrated by the Pere Marquette Railroad. A locomotive traveling fifty miles an hour was stopped in the initial tests by applying brakes controlled by wired-radio impulses. The system was invented by Thomas E. Clark of the Tecla Electrical Laboratories.

The carrier current is sent into the rails of the track from a transmitter located along the route. Loop collector coils under the cowcatcher intercept the waves. The apparatus sends a 28,000-meter wave to indicate the track is clear and a 22,000-meter wave to act as a caution signal. The energy picked up by the coils actuate a visual signaling device in the engine cab. If a red light flashes, it signifies danger; yellow caution, and green, a clear track ahead. The red lamp is illuminated only when there is immediate danger of collision. If a train is occupying a block, the rail surface within that block becomes automatically demagnetized, and another train, entering from the rear or front, will have its red light flashed in the cab and the brakes are automatically applied.

Any tendency of the engineer to exceed the speed necessary in the "caution" zone results in a partial application of the brakes, so that when the locomotive enters the "danger" zone the brakes are automatically set.

Dellinger Gives Version of Fading

THE term "fading," may be incorrect according to Dr. J. H. Dellinger, Chief of the Radio Laboratory, Bureau of Standards. In a broadcast Dr. Dellinger said, "Fading simply refers to the fluctuations of intensity of signals received from distant stations. It is not likely to cause trouble if the station



Wide World

This is the 60-kilowatt motor generator for supplying power to a large tube transmitter at station NAA, Annapolis, Maryland

is within fifty miles, but from that distance up to 200 miles it is a genuine obstacle to satisfactory reception.

"In the daytime the radio waves go out from the transmitting aerial attached to, and sliding along the ground, just as an electric current comes into homes sliding along wires. The waves do not penetrate far up in the air, because of the presence of a sort of electrical screen or barrier produced by the action of sunlight on the atmosphere. At night this screen seems to disappear, allowing the waves to penetrate up into the rarefied upper atmosphere which is permanently in an electrically conducting condition. The waves apparently slide along this conducting layer, just as they slide along the earth's surface in the daytime, but there is a difference. In sliding over the land they are rapidly absorbed by trees, buildings and other obstacles, while along the upper atmosphere, at night, they are free from this absorption, and therefore, cover greater distances."

Dr. Dellinger explained that he believes this is the reason extremely low wavelengths travel further at night. "But this upper layer is not smooth," he continued, "it is rough and turbulent like a wave-tossed sea, and these variations give rise to the fluctuations of received signal intensity called, 'fading.'"

Kadel & Herbert

An interesting military radio exhibit at the electrical show in New York was this portable outfit designed for use by the cavalry. It is carried around on pack mules. It comprises a transmitter and receiver, each of which is effective at distances of from 60 to 200 miles

Rectifier Tubes Based on New Principle

A NEW rectifier tube designed for use in "B" battery eliminators has been developed by C. G. Smith of Cambridge, Massachusetts, and Dr. Vannevar Bush, professor of electrical engineering at the Massachusetts Institute of Technology. It is a full wave rectifier and is known as the "Raytheon." The inventors claim that it is built upon a new principle, the forerunner of which is the "S" tube. The underlying principle is that any gaseous tube which has one very small electrode and one large electrode is a partial rectifier; that is, the current flows more readily when the larger electrode is made negative than when it is positive.

Scientists have been searching for years for insulators that would stand up under intense heat and would not break down under extremely high voltage stress or deteriorate with age. Mica, glass, lava and porcelain have all been tried, but without success. C. G. Smith, during years of development work on a gaseous rectifier, recently discovered that the insulator was the very gas with which he was working. It was found that this and other gases would not conduct current between two electrodes that were close together. The Raytheon was built with this "short-path" insulator as the foundation.

Among the advantages claimed for this

"SLUMBER'S CHAINS" can't always bind us. Especially the boy, to whom radio owes so much. The lure of the air calls him and he slips out of bed to listen "just a minute."

Then comes Dad! How can he be too stern with his boy. Mother finally comes to rebuke but stays to marvel at and enjoy that program from a distant city.

The Eagle Five-Tube Neutrodyne receiver brings the artists' loved voices so clearly that they might be giving their performance right in the room with you. They seem so near you think that if you put your hand out, you must surely touch them.

Set shown is the table type.

Write for illustrated booklet of console models.

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"You have been one of the many who use 'B' batteries that are too small in capacity for their receivers. That is not economical. It makes you buy 'B' batteries twice as often as necessary. Fit the right size Evereadys to your set and add a 'C' battery,* if you haven't one, and you'll get maximum service at minimum cost."

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Here is the secret of "B" battery satisfaction and economy: *With sets of from 1 to 3 tubes, use Eveready No. 772.*

With sets of 4 or more tubes, use either of the heavy duty batteries, No. 770 or the even longer-lived Eveready Layerbilt No. 486.

We have prepared for your individual use a new booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you upon request. It also tells about the proper battery equipment for use with the new power tubes.

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WTAG–*Worcester* KSD–*St. Louis*
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LEFT–*Eveready Layerbilt "B" Battery No. 486, 45 volts, for maximum economy on four, five or more tubes.*

RIGHT–*Eveready DryCell Radio "A" Battery, 1½ volts. The battery built especially for dry cell tubes.*

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–they last longer

*NOTE: In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it.

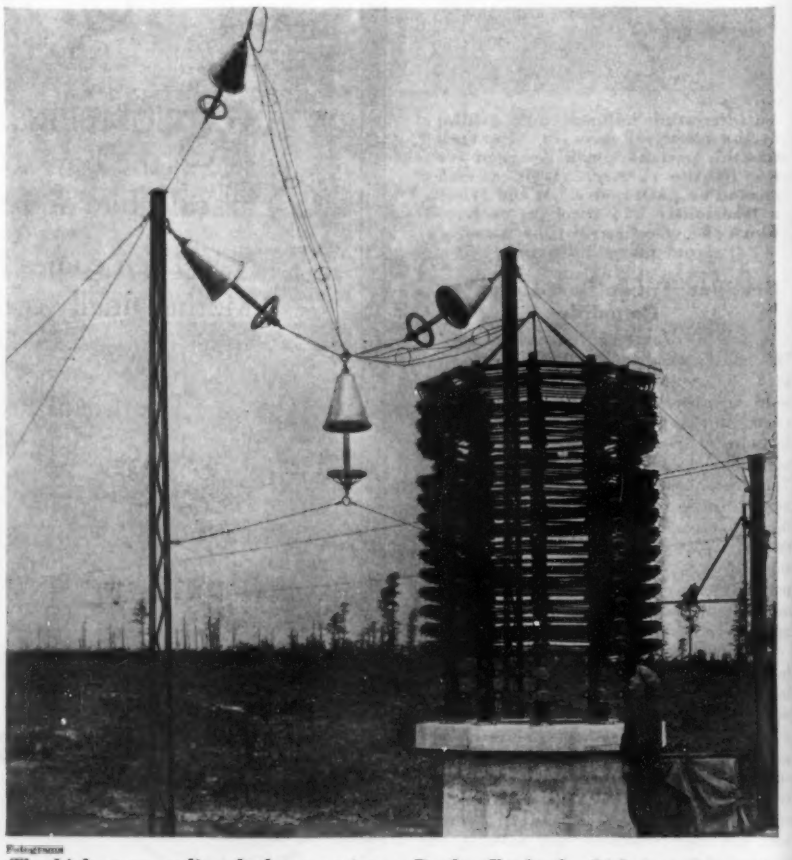
Wide World

A view of the aerial masts at Koenigswusterhausen, Berlin, the recently completed German radio station. It is designed for the transmission of commercial messages and for broadcasting. It can send twenty messages simultaneously

new tube are: no filament to burn out; high voltage output; high current output; excellent regulation, that is, the ability of the device to hold its output voltage at varying conditions of load or current drawn; full wave rectification and long life. The tube can be made to deliver, at the output of the filter, potentials well over 150 volts, especially adapted for use with the new power amplifier tubes as well as with standard tubes. It is possible to obtain over 60 milliamperes without injury to the tube. Under continuous operation of an output of 50 milliamperes it is reported that there has been no sign of diminishing life in any stock tubes tested for 10,000 hours.

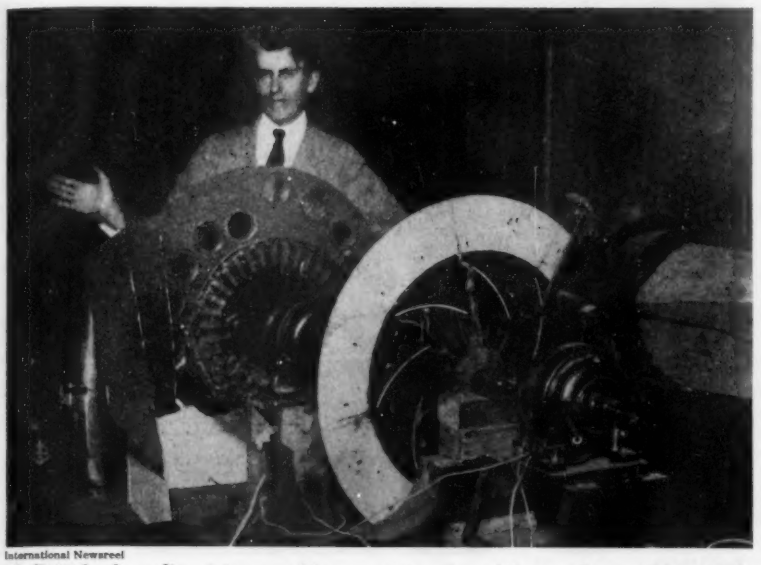
The fact that there is no filament eliminates any necessity of attention during the service life of the tube. No rheostat is required and it is claimed that line surges will not affect the tube.

The gas employed is helium, at a pressure of about 12 millimeters of mercury. The tube depends upon ionization for its action and therefore the vacuum is not nearly as perfect as that used in common amplifying or detector tubes. It is necessary, however, to evacuate the bulb thoroughly before releasing the helium. Only a very small amount of helium is employed in the manufacture of these tubes and this is obtained in the production of liquid air. A quart of helium at atmospheric pressure is said to be sufficient for 700 tubes.



Underwood

The high-power radio telephone station at Rugby, England, which is to be used for transmission to America, is ready for operation. The terminal will be connected shortly with the main London telephone exchange, and telephone subscribers then will be able to call New York. The charge for a three-minute conversation between London and New York will not exceed five dollars. The photograph shows the Rocky Point Station on Long Island



International Newsreel

A Britisher's radio vision machine consists of rapidly revolving disks which contain lenses and cause light to be thrown in succession on a cell which is sensitive to light. The varying strength of the light sets up a pulsating current, which is strong in the high lights and low at the half tones. The current is non-existent in darkness of night.

Chemists Improve Vacuum Tubes

As a result of a search by chemists over a period of one hundred years a new metal of immediate value and vast possibilities has been added to the world's technical resources in the form of pure metallic ductile thorium, which has been prepared for the first time by the Research Laboratories of the Westinghouse Lamp Company.

Thorium is of particular interest to radio enthusiasts because it is the active constituent of practically all vacuum tube filaments. The present method of making radio tube filaments consists of compounding thorium oxide in the tungsten wire, because the thorium has the ability to throw off electrons with greater ease and at a very low temperature. As the tube is heated the thorium oxide comes to the surface of the wire in the form of minute quantities of thorium metal, which gradually oxide off through the emission of electrons. As the thorium on the surface of the tungsten is consumed, more of the thorium oxide within the filament comes to the surface, the service life of the tube ending when the thorium is all used up. Through the use of the new method thorium can now be produced commercially in the filamentary form, as contrasted with the minute admixture with tungsten used at present.

In addition to its use in radio tubes, this metal is of extreme importance to the medical profession as a target material for X-ray tubes, since the thorium is much more efficient than tungsten.

The new metal has been produced by Dr. H. C. Rentschler and Dr. J. W. Marden. It has a purity greater than commercial aluminum. It has the second highest atomic weight of any of the known elements and a hardness about the same as that of soft iron, but is nearly 50 percent heavier. It has a melting point higher than platinum, is easily machined and can be worked cold. It can be made in any shape.

The preparation of thorium in powdered form was first attempted in 1829, and since that time dozens of experiments have been recorded, none of which succeeded in producing a powder suitable for making a ductile metal. The Westinghouse engineers found that they had to devise methods for making chemically pure various ingredients to be used in producing thorium and it was also necessary to develop a special type of furnace and a suitable crucible for heat treating the thorium in a new manner.

The full value of metallic ductile thorium can only be determined in time, just as in the case of tungsten, which some thirty years ago was regarded as a useless curi-

International Newsreel

Our photograph shows Mr. Marconi holding his first transmitter. At the left is Mr. G. S. Kemp, the inventor's chief assistant. Mr. Kemp was with Marconi in Newfoundland on December 12, 1901, when he detected the first transatlantic wireless message, broadcast from the 50-kilowatt spark station at Poldhu, on the southwest tip of England. Viscount Wolmer is in the center

How I Earn $100.00 a Week as a Radio Expert

A year ago I was mighty blue and discouraged. It seemed to me that I would never be more than a low-paid bank clerk. Of course I had a small increase in salary every now and then, but I knew that pretty soon I would reach my limit and there would be no further advancement for me. What future had I to look forward to? Where would I be in five years? I became restless and discouraged and began to look around for some other opportunity.

It was then that I discovered that the demand is for *trained* men, that the opportunities are all for men who can do some one thing better than anything else. There were wonderful opportunities for men who were experts or specialists—but I was—a clerk. How I regretted then that I hadn't prepared myself for some definite career!

I Wanted to Marry

The thing that made me more restless at that time than anything else was the fact that Marian and I were—that is, we wanted to be married. But we both knew that we couldn't possibly get along on my small salary. If only there was something I could do that would bring me a larger salary!

It was just about the time that everyone became so interested in radio. Our whole town became radio-mad, and of course what was happening in our town was happening all over the country—all over the world. I managed to save up enough to buy a receiving set and I was never quite so happy as when I was trying to tune in on stations.

The thing fascinated me. Playing with air waves! Bringing melodies and messages out of the sky! I was never so interested in anything before.

Marian was the first to sense the great opportunity. "Why don't you become a radio expert?" she said. "You like it, and I am sure there must be a big demand for men who understand it. It's a new field and there's plenty of room for wide-awake men."

"But—but I'm not trained!" The thought excited me. To be a radio expert! To find my future in this fascinating new field! "I don't know anything about it, Marian," I said, "I wish I did, though."

"Well, why don't you find out about it," she retorted. "You can't learn about radio just by listening in to the concerts. Why don't you take a course?"

But we found out that most courses were expensive or that they would interfere with my other work. We were about discouraged when I discovered that through the National Radio Institute it is possible to become a radio expert by studying right at home in spare time. I told Marian about it and she was elated. "Send off for information, at once—today!" she exclaimed.

Advances Quickly to $100 a Week

I did, and the following day received an important booklet, "Rich Rewards in Radio," telling all about radio opportunities and how to become an expert in any particular phase of the work.

Here was my opportunity at last!

I began to study in all my spare time. It was the most interesting and absorbing study I had ever made. The secret of the radio revealed to me! Day by day I became more skilled and deft until I was able to take apart receiving sets and put them together again as though I were playing with a toy. It was fun! In a month I was able to take a position as lineman at a bigger salary than I was getting at the bank. This was wonderful experience for me, and I kept right on with my studies. It wasn't long before I qualified for a position as radio engineer at a salary of $100.00 a week! That is what I am earning now, though I expect to make more soon. It seems to me almost too good to be true, after all those years as a low-paid clerk in a bank. And Marian, who will soon be my bride, keeps saying, "I told you so!"

As a radio expert I can tell you that there is a tremendous demand for men who can build, sell and install radio sets, who can design, test, repair. Men are needed as engineers and executives, all over the world. The opportunities are limitless, and if you like radio there is no reason why you cannot qualify for one of these positions by studying in your spare time at home as I did.

The National Radio Institute offers an absolutely complete course which prepares you for the Government First Class Commercial License and for the bigger-paying jobs in Radio. The Director, E. R. Haas, will be glad to send you all details of their marvelous new method of practical instruction, including information concerning the Free Employment Service which secures positions for National Radio Institute graduates. Everyone interested should have this information. *It's free*, and this coupon will bring it to you. I advise you to send it off today. Radio is a new and interesting field, and it offers you more money than you probably ever dreamed possible!

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ACHIEVEMENT, for some of the greatest human works have been—and will be—accomplished in Asia.
MYSTERY, for the Orient builds walls around its secrets.
VISION, for the greatest leaders of the West—Napoleon, Roosevelt, John Hay—have seen Asia as deciding the future of mankind.
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Contents of January ASIA

"MONGOLS" OF TWENTY THOUSAND YEARS AGO—Roy Chapman Andrews, intrepid leader of the famous expedition of the American Museum and ASIA Magazine, which is hunting in Mongolia for the earliest man, tells of his most astounding find of a hitherto unknown race of people—Mr. Andrews' first personal story of this great discovery.

REINDEER IMMIGRANTS—How the white man may continue to eat meat, despite the fast disappearance of cattle and sheep herds, is told in a fascinating romance of pioneering by the famous Lomen family who have turned thousands of square miles of useless Arctic moss into a producing ground for a new world meat supply.

THE HIDDEN KINGDOM OF THE HOUSETOPS—When the air is heavy with the fullness of summer on the housetops of Tunisia, the hidden Arab women come together on the roofs to gossip—like all prisoners, signalling with a secret code from house to house and street to street.

TROUBLE BEHIND THE TROUBLE IN CHINA—The sharp conflict of interests between Japan and Russia in Manchuria and Mongolia was not settled by the Russo-Japanese war. Profoundly significant moves on the inner checkerboard of world conflict over the Far East are laid bare in this article.

"THE MOST RESPECTABLE ANIMAL IN THE WORLD"—So says a handbill of 1797 of the first elephant brought to America from Asia in 1796. "By his intelligence he makes as near an approach to man as matter can approach spirit." A quaint tale of old times.

COMMUNISM versus CHRISTIANITY—Are the teachings of Christ regarding property far different from Communism? How do the two differ? Is the Orient to be the battleground of the two? Startling questions that every Christian will have to answer in his personal life.

INDIGO DAYS IN INDIA—A young Englishman tells how he abandoned the time-honored policy of the white man of "cursing and kicking" the native Indian laborer—and the result. A personal experiment in solving the conflict of two great races.

WESTERN "BARBARIANS" IN JAPAN—The prodigious noses of the first Westerners in Japan nearly three hundred years ago struck the funny note of the Japanese. But the islanders received the first European Christian missionaries with a warm welcome. Why was it that later the Japanese massacred them and sealed up Japan against all foreigners until Commodore Perry arrived?

MIGHTY RESTING PLACES OF ASIA'S MIGHTIEST—America can see and profit by the beauty and dignity of the Orient as mirrored in the great works of art the East built to commemorate its greatest men and women.

Kadel & Herbert

The builder of this broadcaster claims to have produced waves one meter in length. Note the simplicity of the short wave equipment. Yet amateurs are able to talk across the seas with less power than is required to operate an ordinary electric flatiron

osity, but today is the basis of practically all electric lamps, X-ray tubes, high-speed metal-cutting tools and many other similar applications of great commercial value.

A Visual Radio Indicator for Air Pilots

A NEW type of radio beacon tower is to be built at Monmouth, Illinois, as a guide for the Air Mail Service. The new arrangement is based upon an old interlocking signal system. A pilot endeavoring to maintain his course in the direction of the beacon hears a definite signal. If the plane goes to the right or left of the course the signal sounds like the Morse "N" or "A" respectively. While the plane is on the correct course, the two interlocking signals are of the same intensity and a third signal is formed such as the Morse "T" which is a continuous sound. This unbroken sound indicates to the pilot that he is on the right course. If he hears the "A" or "N" signal it is a warning that the plane is to the right or left of the main route. Then he resets the nose of the plane until the constant signal is picked up.

The difficulty with this system has been that the aviator is entirely dependent upon hearing, and that is often unreliable when the airplane engine and propeller are in action. This has been corrected by a visual indicator. It consists of three small lights, mounted on the instrument board and wired to the radio receiver. The constant signal created by the interlocking of the two signals at a point of equal intensity causes a relay to operate a telephone selector, which in turn causes a white light to flash. This light tells the flyer he is on the course. To either side of the route, the component signals actuate relays, which in turn cause the selector to close the circuit, lighting a green or red lamp, one of which indicates the plane is to the right of the course and the other, that it is flying to the left. The visual indicator system is a much safer guide for the pilot than was the old signal system.

Latest Dial Spaces Low-wave Stations

OPERATORS of receiving sets equipped with ordinary variable condensers often find it difficult to separate broadcasting stations in the lower wavelength band, and this has forced manufacturers to develop a new type of condenser with such characteristics that at the lower readings the variation in capacity is small. Such a device is known as a straight-line frequency condenser. There are so many existing sets equipped with the old type of condenser that several manufacturers have introduced what they call a "straight-line frequency dial" or "con-

Kadel & Herbert

Here is shown the complete radio equipment taken from a Martin bomber. On the left is the transmitter, which covers wave lengths of from 850 to 1,200 meters. Next to it is an audio amplifier which uses "peanut" tubes, and next is the receiver which covers a wave band of from 300 to 1,100 meters

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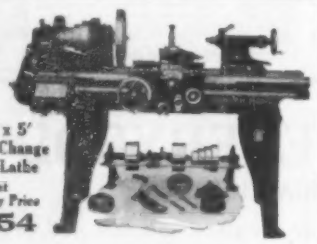

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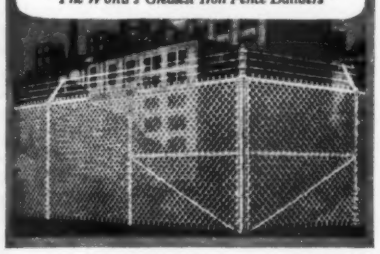

A Pocket 66" Slide Rule

HOW would you like to own a slide rule 66" long? Here is its equivalent in pocket form.

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verter," which spaces the broadcasters evenly across the dial scale.

The converter is in the form of a dial, generally about four inches in diameter, and it can be mounted either by drilling the panel or by gluing it to the panel with four fibre disks which are provided. The only change necessary is to remove the old dial and replace it with one of the new type, which has the added advantage of using the full 360 degrees of the dial, giving double separation between stations and preventing crowding, especially on wavelengths below 300 meters.

New Amplifiers Give More Volume

SEVERAL letters have been received regarding the use of the new UX-120 amplifying tube, and there seems to be some question as to the sets in which this new tube can be employed.

The UX-120 is a dry battery amplifier tube, suitable for use only in the last stage of an audio-amplifier circuit. It can be used in any set equipped with an audio-amplifier unit, and this includes the superheterodyne and neutrodyne receivers. The purpose of the tube is to greatly increase the volume and improve the quality of reproduction from dry battery operated sets. A special socket adapter, known as the UR-556 is required. The plate potential should be 135 volts. A "C" battery of 22½ volts is needed. The proper battery connections are marked on the adapter.

The UX-112 is designed for use in the last audio stage of storage battery sets. It operates from a six-volt filament source. The plate potential should be 135 volts, with a negative grid bias of nine volts.

Canadians War Against Regenerative Howls

THE radio division of the Canadian Department of Marine and Fisheries has issued a circular relative to the correct operation of a regenerative set so that it will not produce howls and squeals in neighbors' receivers. It is estimated that 50 percent of the "preventable interference" is caused by incorrect operation of regenerative circuits. The Canadian authorities are striving to clear the air of regenerative whistles.

The principle of regeneration, as used in radio sets, is that a part of the output of the detector vacuum tube feeds back into its own input and thus greatly increases the volume of the signal.

The Hertzian waves, intercepted by the antenna, travel down the lead-in through the primary coil of the tuner and so to the earth down the ground wire. The weak electric current resulting from this influences the detector tube in such a way as to start it functioning. The resulting output from the plate circuit of this tube is fed back in such a manner as to create a "field" or influence in the part of the circuit connected to the input, or grid circuit. This "field" induces in the grid circuit a current of electricity of the same frequency as that of the received Hertzian waves. The energy, therefore, which comes down the antenna lead-in is automatically strengthened by an impulse from the output of the detector.

Unless properly controlled this action will continue until the saturation point is reached, when the tube is said to be in a state of oscillation. When a receiving circuit is in oscillation it causes howling in the set and in neighboring sets, because it acts as a miniature transmitter. Therefore, regeneration should never be allowed to proceed to the climax, as it then becomes a public menace.

Furthermore, when a receiver is in the state of oscillation, it causes whistles in all types of receiving sets which are tuned to the same station; it distorts the quality of the music or voice; it uses more "B" battery and therefore, reduces the life of the "B" battery; it tends to reduce the life of the detector tube.

It is easy to tell if a set is disturbing the neighbors. Leave the regeneration control in a fixed position, slowly rotate the tuning dial and note the change in the sound of the whistle. If the whistle rises and lowers in pitch sympathetically with the movement of the tuning dial it is an indication that the set is oscillating.

Panels Decorated in a Novel Way

VERI CHROME is a new process for decorating radio set panels. In the past it has been the practice to put the markings on the panel with an engraving machine. It required skilled workmen and the machines were costly. Furthermore, satisfactory work could not be done at night. The Veri Chrome method puts the decoration on rapidly in large quantities, as is the case with lithographing or printing. It costs less than engraving and the volume of production is increased. The amount of decoration put on the panel makes no difference in cost; but with the engraving method each additional line and character adds to the cost. The most elaborate painting or design covering every inch of the panel can be put on with no greater cost than the simple characters and tuning directions that are usually engraved on panels. With engraving the decoration is confined to white lines but with Veri Chrome, gold, silver or any other color can be used. Another source of economy where Veri Chrome panels are used is the fact that the tuning scales can be marked directly on the panel instead of on dials. This allows a knob and pointer to do the work of the more costly dial.

Radio Sets on Farms

A QUESTIONNAIRE circulated by the Department of Agriculture disclosed that only eight and one half percent of the farms in the United States are equipped with radio receivers. In 1924 it was calculated that 364,800 farms owned radio sets and in 1925 the figure grew to 553,003. It was estimated that 26,134 farmers in New York State had radio sets in 1924 and in the fall of 1925 the estimate was 38,750.

Automatic Device Puts Battery on Charge

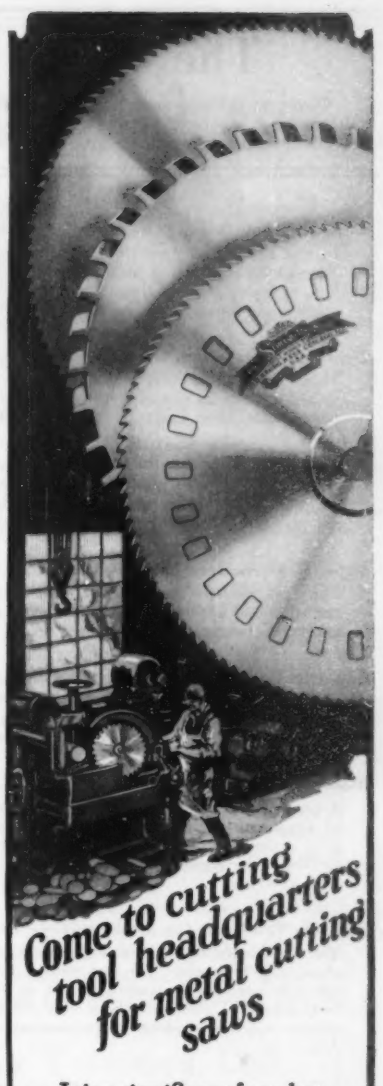
A NEW device, known as a "Regostat," when interposed between the "A" battery and the battery charger, automatically connects and disconnects the charging system, thereby keeping the battery in a charged condition at all times. When the voltage of the battery drops below the point where further discharge is inefficient and detrimental to the plates, an armature drops, closing a circuit which places the battery on charge.

Ships Asked to Stop Code Interference

THE Department of Commerce has signified its willingness to enter into reciprocal relationship with the British and Canadian authorities to prohibit vessels of the countries named from using wavelengths of 300 to 450 meters when within 250 miles of the United States, Canada or the British Isles. Instructions have been sent by the Department of Commerce to radio supervisors, asking that all operators of United States ships be advised to discontinue the use of the wavelengths named when within the specified distance of the coasts.

Largest Carillon on the Air

THE largest carillon of fifty-three bells, the gift of John D. Rockefeller, Jr., to the Park Avenue Baptist Church, New York, are broadcast by WJZ. Forty-five of the bells actually hang in the tower, but the eight largest bells are lower down where there is a firm foundation. The combined weight of the bells is over 50 tons. It is stipulated that each broadcast will conclude with either "America" or the "Star-Spangled Banner."



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The Book Department

Owing to the numerous requests we are receiving for books on ASTRONOMY, the following are suggested as taking the subject from the standpoint of an amateur, or those without technical equipment, to the more advanced stages of the subject.

Curiosities of the Sky by Serviss.....$3.15
In the sky the layman has seen curious bodies, constellations, stars, comets, meteors, lights and has often asked himself what it is all about. This book tells him, and puts him on the road to a more intimate knowledge of that fascinating science, Astronomy.

Beginner's Star-book by McKready..... 5.15
Those who are without technical equipment will appreciate the Author's effort to assist them in claiming through the unaided eyes, or through simple optical instruments, their heritage in the things of the sky.

Why the Weather by Brooks..... 2.15
A popularly written treatise on that most interesting and talked of subject, the weather. The Author attempts to illustrate the many phases of weather science and to emphasize their fundamental laws.

General Astronomy by Jones..... 6.20
Mathematics have been almost entirely excluded in order that the volume may appeal to the amateur, no less than the student. Considerable trouble has been taken to procure a representative series of astronomical photographs.

General Astronomy by Young..... 4.15
Designed as a text-book of astronomy suited to the general course in our colleges and schools of science, and meant to supply that amount of information upon the subject which may fairly be expected of every "Liberally educated" person.

Modern Astrophysics by Dingle..... 8.65
A book which has long been needed. Thoroughly covers the newer developments of astronomy based on the great advances of the 20th century. As non-technical as it is possible to make this somewhat advanced subject, and especially valuable to those who regularly follow Professor Russell's monthly articles in the Scientific American.

John A. Brashear (an autobiography) by Scaife..... 4.15
The autobiography of "Uncle John" Brashear, as he was known to thousands, is above all, romantic. The boy with a love for the stars, who surmounted every obstacle until he became a leader in the making of astronomical lenses and instruments of precision, here tells the story of his heroic struggles. A fitting climax to the student of astronomy. See review in December Scientific American.

All prices postpaid

Useful Aspects of Geology
By S. J. Shand
Prof. of Geology,
Univ. of Stellenboch, S. Africa

For the man who has never picked up any systematic knowledge along this line, here is an account of the various ways in which knowledge of geology can be turned to use, and where to obtain the same. Published by D. Van Nostrand Co. $2.65 postpaid.

A Text-book of Physics
By L. B. Spinney
Prof. of Physics, Iowa Univ.

A complete reference especially strong on Electricity and Magnetism along the lines of recent development. The Third Edition. Published by The Macmillan Co. $3.95 postpaid.

Niagara in Politics
By J. Mavor
Prof. Emeritus of Political Economy,
Toronto Univ.

A sincere and remorseless refutation of the claim that government ownership in the instance of the Ontario Hydro Electric Power Commission has produced beneficial results. Published by E. P. Dutton & Co. $2.15 postpaid.

Technology of Wood Distillation
By M. Klar-A. Rule

The increased interest in fuel substitutes makes this authoritative and complete work most timely. It is precise and determinative, yet readily understood. Published by D. Van Nostrand Co. $6.70 postpaid.

Animals of Land and Sea
By Austin Clark
Smithsonian Institute

Reveals the relationship between human life and the animals which are necessary thereto or are the enemies thereof. The author's distinction as a research investigator lends authority, while his style gives fascination to the subject. Published by D. Van Nostrand Co. $3.20 postpaid.

Clockmaking
By G. F. C. Gordon

The author covers ground which either has not been trodden before or expands details which experience indicates should be amplified. It presupposes acquaintance with Britten's books on fundamentals. Published by N. W. Henley Pub. Co. $5.20 postpaid.

Modern Business English
By A. C. Babenroth
Asst. Prof. of English, Columbia

A practical manual of advanced methods of using words to develop business. The experience and results from the most progressive business houses. Published by Prentice-Hall, Inc. $4.20 postpaid.

Science as Revelation
By J. M. Watson

To counteract the cry that science leads away from religion, the author long under religious instruction, depicts how the truths of nature constitute a dependable revelation by which he has acquired "a newer, higher and holier view of religious belief." Published by The Macmillan Co. $2.40 postpaid.

[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

Science and Money

Rayon

By Henry C. Trundle

THROUGH rayon (the official name for artificial silk) common folks again enjoy the splendor of kings. The very royal purples themselves are made abundant and cheap and the demand is such that a myriad of manufacturing concerns have sprung up, both here and abroad.

Rayon was invented about forty years ago by a Frenchman, the Count de Chardonnet, who discovered that the nitrocellulose obtained by treating cotton linters with nitric acid could be made into a lustrous fibre by pressing it through small dies into a coagulating solution. Other processes have since been discovered—the so-called Viscose process now being used, while the new Acetate process is gaining in importance.

Since about 80 percent of the total rayon produced is manufactured by the Viscose process, it will be of interest to have present information regarding it.

Sheets of spruce wood pulp are first steeped in caustic soda of 15 to 18 percent, then pressed, crumbled, and exposed to air for a day or two. The resultant alkali cellulose is treated with carbon bisulphide, and forms cellulose xanthate, which is dissolved in alkali, allowed to "ripen," filtered, and sent through the jets into the coagulating liquor.

While artificial silk may seem to be a very new product its first commercial development was attempted in 1894, although manufacture was not successful until 1910, nor important until 1912. Its greatest progress has been in most recent years, due in part to enlarged markets, such as are enjoyed by motors, radios, and so on.

Rayon Contributes to Textile Industry

Rayon does not have the same chemical analysis as silk, nor is it claimed to be an imitation silk. The entrance of this new fibre into the textile field has been of great aid in the revival of the textile industry. Styles have changed from heavy, plain cottons and woolens to the lighter colored fabrics. Alone and in combination rayon has met these changes, and even led in a further exploitation of its uses. It is said that there is no branch of the textile industry, the future of which appears more promising than the artificial silk trade. America now leads in the production of rayon and it will undoubtedly be to the artificial silk world what Japan is to the natural silk market.

At first rayon was used principally for knitted outerwear, underwear and stockings. Now rayon—cotton mixtures, draperies and upholsteries have opened up extensive markets. Further uses are in electrical insulation, tire fabrics, and as a substitute for rubberized silk. It has been found adaptable to the many uses of silk at less than one third the cost.

Is this substitution of rayon for silk causing a fall-off in production of natural worm silk? Quite the contrary is the case as the following comparative tables will show. Figures are in pounds:

	Rayon Consumption	*Raw Silk Consumption*
1925.....	58.000,000	*33,174,000
1924.....	40.562.000	51,281,000
1923.....	39,287,000	49,506,000
1922.....	26,494 000	50,711,000
1921.....	18.667.000	45,355,000
1920.....	9,847,000	30,058,000
1919.....	9,149,000	44,817,000
1913.....	3.871,000	27,979,000

**For 7 months ended July 31.*

The increased rayon production is indeed notable, especially in view of the large raw silk production. Because it so excellently combines with other fabrics to make modish materials, the demand for it is strengthened as new creations are desired in style changes.

Companies engaged in the manufacture of rayon have not been wont to give out statements as to production costs, profits, and similar statistical data. The largest producers are concerns such as du Pont, which have developed rayon as a sort of a side line, merging any profits with those from other corporate activities. A reading of a balance sheet or earnings statement, therefore, discloses nothing to the person interested solely in the rayon branch. Either this situation is present, or we have the foreign concerns, which have adopted a policy of strict secrecy regarding derivation of income. The officials of the American subsidiaries of these, however, are more liberal and are at least issuing part statements. As additional capital is needed for plant construction and other extensions, more complete financial statements will be available to the public.

Future Expansion Hinted

Offerings of stock in rayon companies have recently come upon the market in number. In some cases it is just the distribution in the United States of shares in European companies, well established and formerly known as successful money makers. This popularization in our country of these foreign industrial shares may be by way of preparing for further financing to meet future expansion requirements. Such sale of stock also has the tending to make the product rayon better known, since it will thus be the study of investors, merchantmen and others, as well as of the actual buyers and users.

Other companies which are offering stock (and of which we may expect a superabundance) are comparative newcomers in the field, and their financial statements will for the most part be estimates of expected profits rather than the publishing of actual results. Capitalists, large and small, will seek to form companies, with successful manufacturers in other lines as the heads, to go after the large profits that are apparently to be had.

New stocks that have been placed on the market and traded in have gyrated grandly in price. Original offerings have been at about $20 to $25, and have later been run up to $50 to $70, with subsequent reactions of 20 to 25 points. If we can believe that the underwriting bankers priced these stocks correctly at the time of issue, it is hard to understand that business has increased so much in the intervening period of only a few months to justify such a rapid and high appreciation in market price. It may develop that such is the case, although it now appears that the future has been considerably discounted, with just a touch of market sentiment and speculative ambition thrown in.

Purchasers of rayon company stocks will safeguard their interests in a large measure if they are careful in the selection of the bankers through which they may deal.

Despite increased production facilities, manufacturers of rayon have had their output contracted for months in advance. This fact is most encouraging and portends well. For the year 1926 the American production is estimated to approximate 75,000,000 pounds; 80 percent of which is expected to be manufactured by two leaders in the field. The prevailing opinion is that while supply may more nearly approximate demand than this year there is little danger of over-production with a subsequent accumulation of stocks to be carried over into 1927.

One important factor which will assure a rapid expansion in the rayon industry is that prices have been stable. Manufacturers have held to this policy rigorously and it has contributed much to the proper develop-

ment and stabilization of the industry. Raw silk prices have changed continuously during the year and users have found it necessary to watch the original markets closely. Trade reports have constantly given out warnings of further price advances, of lessened supply, and have urged that commitments be "hedged." This situation is annoying to manufacturers, and they welcome a stabilized price for rayon. The effect on the rayon trade is obvious, especially since production is limited only by plant capacity.

Not all companies with the word "rayon" in their corporate names are or will be manufacturers of the fibre. Some of these limit their business to the manufacture of fabrics using rayon in its structure. Discerning investors may prefer to associate themselves with this type of manufacturer rather than with the maker of rayon itself, in the belief that over a period of years there may be greater stabilization.

Investors want to have the opportunity to share in the profits from this new industry. They will have this privilege. The question for them to decide is into which companies they care to buy a partnership. It is interesting to note that in the past earnings were published at the time of security offering, but afterward the shareholder could guess his own figures and the stocks drifted along for themselves. One such stock declined to a very low figure shortly after the offering, despite the published earnings of $30 per share. A recent quotation was above $200—indicative of a better appreciation of the industry and of the ability of this particular company. Since there is now a better understanding of the industry, such an occurrence may not again happen.

With proper selection, the public should make money along with the rayon companies. Sound economic factors are present. Demand is growing with widening markets. Stable prices and controlled supply, in contrast to the fluctuating prices and undeterminable supply of natural silk are all in favor of rayon.

The Heavens in January

By Professor Henry Norris Russell, Ph.D.

At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9½ o'clock: Jan. 29.

NIGHT SKY: DECEMBER AND JANUARY

The Heavens

THE winter constellations are now at their finest. Orion is due south, with Aldebaran above, on the right, and Sirius below on the left. Far down on the horizon, dwellers in latitudes south of thirty-five degrees may catch a glimpse of Canopus—the second in brightness of all the stars—a little to the right of Sirius. Gemini and Auriga are almost overhead and Canis Minor high in the southeast. Leo is the principal constellation in the east, and Ursa Major in the northeast. Draco and Ursa Minor are in the north, Perseus, Andromeda, and Cassiopeia in the northwest, and Cetus and Eridanus in the southwest.

The Planets

Mercury is a morning star this month but is far south and poorly placed. He rises about 5:45 A.M. on the first, and may be visible in the early part of the month.

Venus is an evening star, and at her brightest, excelling Sirius thirteen-fold in light. She sets at 8:00 P.M. on the first, and is very conspicuous. Later in the month she draws in rapidly between us and the sun, and by its end she is lost in his rays. Telescopically, and even with a good field-glass she may be seen as a fine crescent.

Mars is a morning star in Ophiuchus, and rises about 4:00 A.M. in the middle of the month.

Jupiter is at first an evening star, although too near the sun to be seen. On the twenty-fifth he is in conjunction with the sun, and becomes a morning star.

Saturn is a morning star in Libra and rises about 3:00 A.M. Uranus is in Pisces and observable in the evening; Neptune is in Leo and is visible almost all night.

The moon is in her last quarter at 2:00 A.M. on the seventh, new at 2:00 A.M. on the fourteenth, during the eclipse, in her first quarter at 6:00 P.M. on the twentieth, and full at 5:00 P.M. on the twenty-eighth. She is nearest the sun on the fourteenth and remotest on the second and twenty-ninth.

During the month she passes near Neptune on the second, Saturn on the ninth, Mars on the eleventh, Mercury on the twelfth, Jupiter on the fourteenth, Venus on the sixteenth, and Uranus on the seventeenth. None of the observable conjunctions are close.

An Account of Stewardship

FIFTY years ago Dr. Alexander Graham Bell was busy upon a new invention—the telephone. The first sentence had not been heard; the patent had not been filed; the demonstration of the telephone at the Centennial Exposition had not been made. All these noteworthy events were to occur later in the year 1876. But already, at the beginning of the year, the basic principle of the new art had been discovered and Bell's experiments were approaching a successful issue.

The inventor of the telephone lived to see the telephone in daily use by millions all over the world and to see thousands of developments from his original discovery.

If he had lived to this semi-centennial year, he would have seen over 16,000,000 telephones linked by 40,000,000 miles of wire spanning the American continent and bringing the whole nation within intimate talking distance. He would have seen in the Bell System, which bears his name, perhaps the largest industrial organization in the world with nearly $3,000,000,000 worth of public-serving property, owned chiefly by an army of customers and employees.

He would have seen developed from the product of his brain a new art, binding together the thoughts and actions of a nation for the welfare of all the people.

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AND ASSOCIATED COMPANIES

BELL SYSTEM

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1864 — 1926

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Process Engraving

WHAT constitutes engraving and what does not is discussed at length by the Federal Trade Commission in its decision, finding the Process Engraving Company guilty of so misnaming its product as to constitute an unfair method of competition.

"In producing engraved products for commercial purposes, characters or drawings are engraved upon copper or steel plates or dies in intaglio, the depression filled with ink, surplus ink removed from the surface of the plate, and the sheet taking the impression brought into contact with the plate under pressure in special presses in a process known as 'plate printing,'" says the Commission. "Thus has been produced the work known commercially as 'engraving,' using the term without qualification."

The respondent produces an imitation engraving which has become popular in recent years which it calls process engraving. This is the result of the use of a chemical in powdered form which is applied to type printing while the ink is still wet; this chemical adheres to the wet ink and in passing through a baking process the heat causes it to fuse and present a raised letter effect so as to resemble in appearance the impression made from engraved plates.

Such products, the Commission finds, "do not resist temperature changes or handling so well as matter printed from engraved plates, nor so well as plain flat printing, but its simulation of true engraving in effects produced, makes it more attractive to customers than plain, flat printing, and it has the advantage of being less expensive than true engraving."

Henry Ford on Patents

HENRY FORD recently had this to say about patents:

"Patents are silly things when they are used to hinder any industry. No man has a right to perfect a patent for profit only. That produces parasites; men who are willing to lie back on their oars and do nothing. If any reward is due a man whose brain has produced something new and good, he should get it through profits from the manufacture and sale of the thing.

"We take patents on our own developments and discoveries only to prevent others from freezing us out when they may have a chance to make the same discoveries. We use patents to prevent a shut-out game. We believe in the gospel of use."

Mr. Ford comes pretty close to agreeing with the Constitution which gives Congress power "*to promote the progress of science and of the useful arts* by securing for limited times to inventors exclusive right to their respective writings and discoveries."

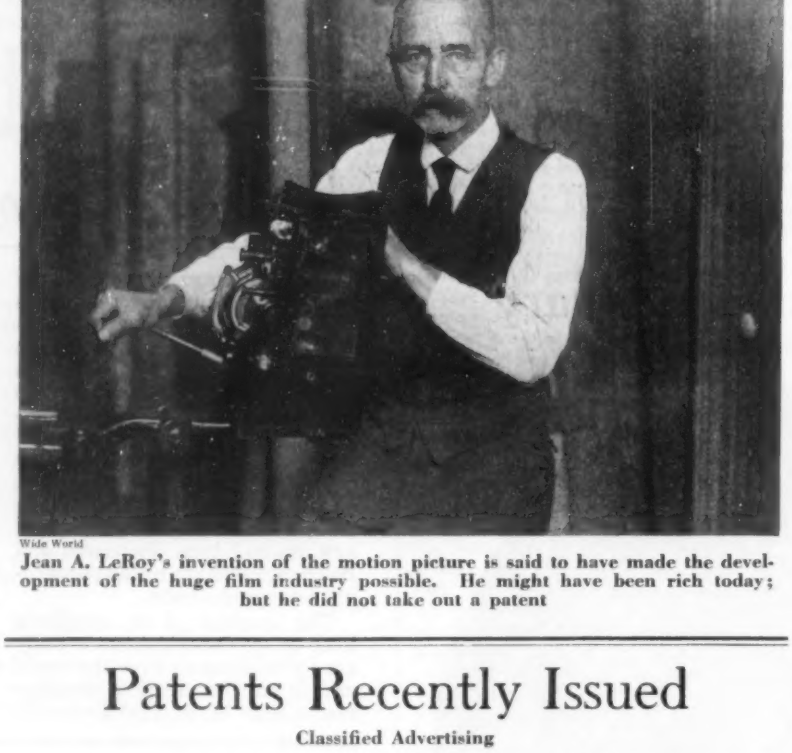
When Do Inventors Invent?

THE autumn tide of inventions is now at the flood. Next month it will begin to recede, until, in December, it reaches the lowest ebb of the year. Then it will swell again until March, when it will attain its high mark. Then it will ebb again as summer draws near.

Every year, as regular as the ocean tides, the tide of inventions ebbs and flows. In the early spring the greatest number of inventors seek patent attorneys and in the summer months the least. Many explanations have been offered as to just why this is so. Perhaps the real explanation is something like this:

In the winter months the farmer, with time hanging heavy on his hands, has been tinkering away with an idea he has for doing something in a better way, and the man in the shop, as the wheels speed up, sees more clearly the need of some new device or process. By early spring they have each perfected their invention and are ready to seek patent protection. Then, as summer draws on and the mechanic looks forward to playing outdoors and the farmer to working from dawn to dusk, there is less time for inventions. Some use the vacation season to work out new ideas; the rise in the number of applications in the fall shows that.

But how about the drop in December, all by itself, you ask. Why, that's the month Christmas comes in and every inventor must use all his resources—mental resources, of course—to help Santa Claus.



Wide World

Jean A. LeRoy's invention of the motion picture is said to have made the development of the huge film industry possible. He might have been rich today; but he did not take out a patent

Patents on the Tax Return

ALTHOUGH it is intangible, a patent is just as real a business asset as a factory building. Each year the value of this asset may depreciate, because the date of expiration when it will be worth nothing at all, is drawing nearer. Can you, then, deduct such loss from your company's tax return?

Why not? The United States Board of Tax Appeals recently in the case of the appeal of the Union Metal Manufacturing Company says:

"Section 214 (A) (8) of the Revenue Act of 1918 provides for the deduction of a reasonable allowance for exhaustion, etc., of property used in the trade or business. We know of no ground for holding that this means all property except patents. We not only have no right, but in this case we can find no sensible reason to write such an exception into the statute."

Trimming the Patent Office

RECENTLY the superintendent of the War Department held a hearing to consider the question of widening F and G Streets adjacent to the Patent Office. This would mean cutting off the portico and high steps of the building. A number of persons are protesting, saying that the steps serve as a pedestal for the monument-like structure. Among other objectors is the *Journal of the Patent Office Society* which declares:

"The removal of this beautiful portico with its double row of Doric columns would necessarily be a severe blow from an architectural standpoint."

Old timers may remember the criticism of the south front as an architectural blunder when the building was completed. The *Washington Star* of October 15, 1875, said:

"The symmetry of the south front of the Patent Office building is sadly marred by the lately completed south entrance, the flight of steps being almost as high as the building itself."

You cannot please all of the people all of the time.

The Invasion of Canada

THE Canadian Commissioner of Patents recently issued his annual report showing that in the last year 9,508 patents were issued in the Dominion. One statement in it is as follows:

"Of the total number granted, 6,580 were applied for by residents of the United States. This is 69 percent of the whole issue and is 4 percent more than were issued to United States inventors last year. Applicants resident in Canada contributed 1,302, or over 13 percent of the total. This is a decrease of nearly 4 percent. Residents of Great Britain and Ireland and the British colonies and possessions applied for 846, or nearly 9 percent of the issue. This is the same percentage as last year."

In other words, American inventors and manufacturers have a growing appreciation of Canada as a market for American inventions.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Electrical Devices

RADIO STATION INDICATOR.—Which can be readily applied to any panel-board and connected to the shaft of a turning element. Patent 1555743. E. G. Ballenger, 805 Healey Bldg., Atlanta, Ga.

COIN DETECTOR.—In the form of a coin-responsive electric system, operable only on receipt of a genuine and unadulterated coin. Patent 1555910. F. R. Chester, 1416 Broadway, New York, N. Y.

ELECTRIC LIGHT UNIT.—For use in connection with the standard outlet, which can be easily installed, and securely attached without wood screws. Patent 1557515. F. E. Wooley, 66 Central Ave., Manasquan, N. J.

BURGLAR ALARM.—That may be associated with any telephone set without attaching any parts of the alarm to the telephone set. Patent 1557373. A. D. Sindt, 246 W. 108th St., New York, N. Y.

COMBINED TELEGRAPH RELAY AND TELEPHONE.—Having a telephone and telegraph key combined therein, so that either may be employed in transmitting over a single wire. Patent 1557247. W. R. Garner, 123 W. 61st St., New York, N. Y.

ELECTRICAL DISPLAY APPLIANCE.—Which may be used to attract attention to any particular exhibition or display in a store window. Patent 1557430. L. R. Crow, 672 E. Locust St., Vincennes, Ind.

LINE TESTING APPARATUS.—Equally well adapted for testing metallic or grounded circuits, is compact, convenient to carry and safe and reliable in operation. Patent 1558,211. C. D. Williams, Silver Lake, Kan.

PROCESS OF MAKING DRY BATTERIES.—Whereby a paste may be made without the usual cooking apparatus, and the expenditure of heat. Patent 1558413. B. H. Teitelbaum, c/o Bright Star Battery Co., Terminal Bldg., Hoboken, N. J.

ELECTROCENTRIFUGAL SEPARATOR.—Which involves the separation of suspensions or emulsions by simultaneously employing the action of an electric field and centrifugal force. Patent 1558382. A. Marx, 162 Boulevard Voltaire, Paris, France.

Of General Interest

REFRIGERATOR.—So constructed that a large number of articles may be cooled, and selectively removed without disturbing any of the other articles. Patent 1551879. R. O. Hoffman, Box 682, Pensacola, Fla.

CIGARETTE HOLDER.—Having a stem which is movable to effect the ejection of the cigarette stump or grip the cigarette in normal position. Patent 1551973. B. L. Brooks, Beasley Bldg., Lynchburg, Va.

FISH-SCREENING DEVICE.—Adapted to be positioned between the side walls in an irrigation, or like conduit. Patent 1551967. J. Nample, Reichle, Mont.

FRUIT, VEGETABLE, FISH AND MEAT DEHYDRATING APPARATUS.—For dehydrating by artificial heat, the materials being distributed on wire mesh bottom trays, increasing in size as the sections ascend. Patent 1552210. M. E. Bussler, 521 St. Philip St., New Orleans, La.

COLLAR BUTTON.—So formed as to permit the application or removal of the collar, without distorting or tearing the button hole. Patent 1548974. A. O. Benson, 1641 W. 55th St., Los Angeles, Cal.

MOVABLE FORM FOR CONCRETE CONSTRUCTION.—Which can be moved from finished portions of a wall and applied to the upper edge for pouring a continuation. Patent 1550051. C. M. Alley, Upper Lake, Cal.

PROCESS FOR MAKING ARTIFICIAL MARBLE. Consisting of a mixture of calcined magnesite, sand, Portland cement, asbestos fiber, magnesium chloride, magnesium sulphate, and calcium chloride. Patent 1550077. H. J. Kimmel and L. A. Harris, 3 Railway Ave., San Francisco, Cal.

RAT TRAP.—In which the weight of a rat entering serves to close a compartment and prevent return to the entrance. Patent 1552377. J. J. Althousen, Evansville, Ind.

SAFETY DEVICE FOR ELEVATORS.—Whereby in event of failure of the usual automatic safety device a manually actuated means is provided. Patent 1552263. D. Bird, 176 Undercliff Ave., Edgewater, N. J.

METHOD OF TRANSFERRING COLORS.—From a pattern sheet using soluble dyes to a fabric, by the use of a moist cloth and hot iron. Patent 1552374. P. Yohns, 1046 Lexington Ave., New York, N. Y.

INDICATOR.—For indicating in darkened theatres whether or not a particular seat is occupied, the illumination being non-electrical. Patent 1552265. C. and J. K. Brachvogel, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, New York, N. Y.

GARMENT HANGER.—Which can be stowed away in a trunk or suitcase and occupy a very small space. Patent 1551769. J. P. Paddington, 516 E. 72d St., New York, N. Y.

WINDOW SHUTTER AND SLATS THEREFOR. Which may be applied to an ordinary wood window frame, and is provided with novel means for opening and closing the slats. Patent 1551753. L. Lane, Box 1066, Habana, Cuba.

CONVERTIBLE FIGURE TOY.—Readily convertible from an ordinary doll, to simulate animals of various kinds. Patent 1552348. S. H. Rosenthal, 400 E. 3d St., New York, N. Y.

LADDER PLATFORM.—Which may be removably connected to an ordinary ladder, to securely hold the ladder against the corner or side of a building. Patent 1553279. J. Wirth, 241 E. 79th St., New York, N. Y.

RAT GUARD.—Especially adapted for use with cables or hawsers employed in tying ships to docks or wharves. Patent 1553254. R. Mallu, 619 Eleysian Fields Ave., New Orleans, La.

SPOOL HOLDER.—Which will serve to support a spool of thread, and is also provided with a thread cutter. Patent 1553275. T. E. Washburn and Z. T. Hull, Box 1041, Coalinga, Cal.

OIL CAN.—Having pumping means to forcibly eject a limited quantity of oil at each operation. Patent 1553245. F. I. Jaden, Hastings, Neb.

DOOR FRAME CONSTRUCTION FOR BUILDINGS.—Whereby the connection between the supporting frame and the plaster is unusually effective and simple. Patent 1553,228. E. Flagg, 111 E. 40th St., New York, N. Y.

METHOD AND MEANS FOR PRODUCING BIAS FABRICS.—From non-bias fabrics, for the production of individual neckties and other articles. Patent 1553174. M. M. Kasanof, 1746 59th St., Brooklyn, N. Y.

Hardware and Tools

WRENCH.—The adjustment of which may be readily made and after once set, the hand grip maintains the jaws in position. Patent 1556523. A. G. Hughes, 312 W. 15th St., New York, N. Y.

GRAVER SHARPENER.—Adjustable to any desired angle for properly supporting the tool for sharpening, polishing or honing the cutting end. Patent 1556471. E. M. Andrus, 315 Third St., Macon, Ga.

SAFETY HOOK.—Embodying a simple locking device, which will prevent the accidental slipping of a chain link in the logging industry. Patent 1555359. J. Delahunt, Route 1, Bow, Wash.

MIXING FAUCET.—In which hot and cold water may be mixed to provide a common flow at the desired temperature. Patent 1555948. A. Engel, 948 Union Ave., Bronx, N. Y.

COMBINATION TOOL.—Comprising a handle containing a plurality of implements with locking means to hold any one of the implements. Patent 1556788. P. W. Hallvarson, 130 Ninth Ave. W., Calgary, Alberta, Can.

Heating and Lighting

AUTOMATIC GAS-CONTROLLED WATER HEATER.—Having thermostatic means controlling the flow of gas to the burner in accordance with the temperature of the water. Patent 1551885. H. G. Jensen, 3745 Crane Ave., Detroit, Mich.

MEANS FOR BURNING OIL.—Without the deposit of hard carbon in the vaporizer, or the internal deposit of hard carbon in other parts of the apparatus. Patent 1553986. G. S. Clyde, 788 Orange Ave., West End, Long Branch, N. J.

AUTOMATIC FIRE-CONTROL AND FUEL-ECONOMIZER SYSTEM.—For oil burning furnaces, wherein the amount of air supplied will be automatically varied according to the quantity of oil used. Patent 1554869. J. J. McAndrews, Greenbridge St. and Coppswell Ave., Jamaica South, L. I., N. Y.

OIL BURNER.—Adapted to be applied to most any type of burner whereby oil and superheated steam can be efficiently used. Patent 1555684. F. X. Mantsion, Ashton and Willits Roads, Homesburg, Philadelphia, Pa.

OIL BURNER.—In which liquid fuel is changed to a vapor, and subsequently distributed over a generating hot plate. Patent 1557954. R. E. Wood, Syracuse, Neb.

Machines and Mechanical Devices

EGG PROCESSING.—To preserve the eggs by submerging them for a short time in a bath of heated oil, and draining off the surplus oil. Patent 1553185. W. H. Rousel, 152 Clay St., San Francisco, Cal.

SLICING MACHINE.—Which will cut strips of pearl shell commonly known as "blanks" into a plurality of buttons. Patent 1553227. A. Feyk and P. F. Dusha, c/o Victor P. Nekarada, 230 Fifth Ave., New York, N. Y.

TUBING CATCHER.—In the nature of a safety catch for use in lowering tubing into a well casing. Patent 1553195. H. R. Smith, Siloam Springs, Ark.

DAMPER REGULATOR.—Which is provided with a pressure cap and construction of post and strut receiving and engaging the scale beam. Patent 1553236. J. C. C. Harris, c/o Lock Regulator Co., Salem, Mass.

MACHINE FOR THE MANUFACTURE OF STRIPS OF MATCHES FOR BOOK MATCHES MADE OF WOOD, CARDBOARD, AND THE LIKE.—Automatically manufacturing the strips for uniting to form a book. Patent 1553,900. W. Huhnd, c/o C. Fehlert & Co., S. W. 61, Belle-Allianceplatz 17, Berlin, Germany.

PUMP JACK.—With means for preventing injury to the mechanism or associated parts of oil well equipments in the event of breakage. Patent 1553486. E. R. Thomas and P. E. Langfitt, Box 948, Shidler, Okla.

CASTING DEVICE FOR TYPE METAL.—Whereby type metal of any desired cross section can be cast in a continuous process. Patent 1551838. F. B. Myers, Oakland, Cal.

SLING.—For use in the art of loading and unloading, with means for so balancing the load that it will alight firmly. Patent 1551,886. T. W. Jensen, Berkeley, Cal.

HEAD GATE.—Adapted to be used in connection with irrigation ditches for the purpose of controlling the flow of water. Patent 1551883. A. G. Humphrey and H. C. McCarthy, Ripley, Cal.

WIRE TENSION DEVICE.—Adapted to impose a tension which may be varied at the time the wire is moving in the direction of its length. Patent 1553978. A. H. Braid, Box 217, Summerville, S. C.

CABLE-SNUBBING DEVICE.—To be secured on the frame of a derrick for use in checking longitudinal movement of a cable engaged with the device. Patent 1553430. D. D. Bittle, c/o Comar Garage, Marland, Okla.

WATER FILTERING PLANT.—The water being purified by passing through sand which from time to time is sterilized by a steam process. Patent 1554129. L. Ryan, 4240 McPherson Ave., St. Louis, Mo.

SHOVEL AND DREDGE.—For light and rapid work, and may be incorporated as a unitary structure in a tractor driven by a stationary engine. Patent 1554131. J. A. Scharf, 142 So. Fulton St., Richmond, Ohio.

DRAFT APPLIANCE.—For use with stump pulling mechanism, having means for supporting the sheath and connected parts in proper position during the operation. Patent 1553692. T. W. Huckle, c/o Ferndale Boat Works, Miles Road and Woodward Ave., Ferndale, Mich.

CHANGE-MAKING MACHINE.—Driven from a prime mover and actuated by the insertion of the coin or coins, thus eliminating the necessity of an operator. Patent 1553979. F. J. Bryk, 17 Elizabeth St., Jersey City, N. J.

CASING CATCHER.—A device which may be employed to automatically serve as a means for catching a string of casing, or a section of string, in case the same drops when being lowered into, or raised from, a well. The inventor has been granted two patents of a similar nature, 1553904 and 1553905. J. K. Livingston, 1215 So. Norfolk St., Tulsa, Okla.

MECHANISM OF UPRIGHT PIANOS.—For the special purpose of obtaining a more perfect and rapid repetition of the hammer stroke on the wire. Patent 1554977. O. P. Borgarello, c/o G. Breuer, Calle Maipu 671, Buenos Aires, Argentina, S. A.

SHOE-TREE-MAKING MACHINE.—For automatically feeding the stock to the cutters and automatically discontinuing the action upon completion of the cutting operation. Patent 1554878. O. Olson, 168 E. 29th St., Brooklyn, N. Y.

BRICK-CLEANING MACHINE.—Especially adapted for cleaning off surface collections in used paving brick, in preparing the same for reuse. Patent 1554582. T. L. Krupitzer, Box 220, R. 7, South Jacksonville, Fla.

PORTABLE COAL TIPPLE.—Having means for leveling and supporting the wheeled platform when the tipple is in use, or moved from place to place. Patent 1554885. G. C. Singer, Oakland City, Ind.

SNOW REMOVER.—Having means for gathering the snow, and directing it as conveyor means, in the form of a wagon. Patent 1555777. D. Van de Genachte, c/o Arvon Co., 105 W. 16th St., New York, N. Y.

EGG BOILER.—For automatically regulating the time of immersion of an egg, or other article of food, in boiling water. Patent 1555491. I. W. Tufts, 2403 Carondelet St., New Orleans, La.

Railways and Their Accessories

CAR-BRAKE RATCHET.—Giving speedy action for the controlling of brakes on freight cars, especially box cars. Patent 1553278. O. D. Willis, 633 Fourteenth St., Huntington, W. Va.

RAIL FASTENING DEVICE.—Which makes it practically impossible for a spike to be removed from a tie, except by use of a claw bar. Patent 1553176. S. B. Kull, Roslyn, L. I., N. Y.

GRAIN-CAR DOOR.—In the nature of an auxiliary door to be employed beneath any approved main door. Patent 1554421. J. E. Drake, Blue Rapids, Kan.

DEVICE FOR REMOVING SNOW AND ICE FROM RAILWAY TRACKS.—Which will clear the vicinity of the trolley slot, and remove and deflect the snow from the track rails. Patent 1555778. D. Van de Genachte, c/o Arvon & Co., 105 W. 16th St., New York, N. Y.

TRAIN CONTROL.—Pertaining more particularly to means for automatically operating the engineer's valve to either service or stop position. Patent 1558360. G. P. Horan, 12 Madison St., Rutland, Vt.

RAILWAY-BAGGAGE COUPON TICKET.—Comprising a plurality of detachable ticket portions, each having indicia indicating transportation between designated points and the serial number of the ticket. Patent 1558780. W. R. Betham, Decd., Mrs. E. A. Betham, Executrix, c/o E. H. Harwood, 502 Green St., South Haven, Mich.

Pertaining to Recreation

GAME APPARATUS.—In the form of a folding game board, with means for holding the game pieces on the board when moved. Patent 1552344. D. Reisz, 10010 South Blvd., Cleveland, Ohio.

TOY.—Designed to represent a horse, or any other animal, on which the rider can propel the same to simulate a gallop. Patent 1553219. H. B. Crosby, 42 So. Street, Calais, Me.

GAME APPARATUS.—Played with representations of several types of hands cut into pieces, which may be fitted in position to represent normal or grotesque types of hands. Patent 1555747. G. A. Lindsay, Hotel Ansonia, 73d St. and Broadway, New York, N. Y.

GAME.—The playing of which will provide an understanding of the steps which are involved in the drilling of an oil well. Patent 1555900. T. A. Carson, Jennings, Okla.

TOY PISTOL.—Formed of spring wire, and adapted to project fruit pits, marbles, small stones and like pellets a considerable distance. Patent 1555912. W. R. Davis, Wallace, Idaho.

TOY BALL.—Made up of hinged sections adapted to fly apart when certain portions of the ball are struck. Patent 1557751. W. H. Winks, 404 E. Randall St., Baltimore, Md.

STRIKING BAG.—For exercising purposes, the bag permitting the use of a laced side opening and a complete closure at the reduced portion. Patent 1557938. B. Kennedy, c/o Ken-Wel Sporting Goods Co., Gloversville, N. Y.

Pertaining to Vehicles

BOLSTER AND STANDARD CONSTRUCTION.—For wagons or like vehicles, of light weight and at the same time strong, being made entirely of metal. Patent 1554909. N. J. Eldridge, c/o Wm. Muller, Grand Island, Neb.

VEHICLE SEAT.—Particularly adapted for the driver's compartments, the seat being attached to the side wall of the car swinging outwardly to provide access to the interior. Patent 1554872. J. E. Meyer, c/o B. T. Bush, Delawanna, N. J.

SPEED INDICATING DEVICE.—For use on motor vehicles indicating to the public and driver the speed, or approximate speed at which the vehicle is traveling. Patent 1555309. Samuel R. Mott, 4500 Euclid Ave., Cleveland, Ohio.

SIGNALING DEVICE FOR AUTOMOBILES.—Which may be worked from the interior of a closed car to indicate the direction of travel, or a stop. Patent 1555193. G. Elbert, 809 E. Second St., McCook, Neb.

ADJUSTABLE AUTOMOBILE TABLE.—Adapted to be extended across the interior and to effectively engage the sides in supporting relation. Patent 1555038. R. F. Thweatt, c/o Thos. B. Losey, 504 1st Natl. Bank Bldg., Chickasha, Okla.

ATTACHMENT FOR ACCELERATOR PEDALS.—By means of which the operation of the pedal is steadied, preventing the sudden, jerky opening and closing of the throttle. Patent 1554492. J. M. Brennan, 639 W. 36th St., Los Angeles, Calif.

VEHICLE WASHER.—In which the vehicle may be passed between brushes for the purpose of removing dirt from the sides. Patent 1555754. J. Peterson, 1542 103d St., Ozone Park, L. I., N. Y.

AUTOMOBILE PARKING MACHINE.—In the nature of vertically and laterally movable platforms, for supporting and storing a large number of cars in a relatively small space. Patent 1555692. J. E. Morton, 5 Murdock Aptmts., West Lafayette, Ind.

MOTOR WAY.—Comprising specially arranged tracks for slow moving and fast moving vehicles, on a roadbed of comparatively light structure. Patent 1554425. C. P. Eldredge, Mill Valley, Calif.

SPRING OILER.—Which utilizes a pressure of air to separate the leaves of springs while lubricant is forced between them. Patent 1556460. F. Thill, c/o Saunders, Young & Grann, 144 N. E. 2d Ave., Miami, Fla.

COMBINATION WHEEL.—Of the combined cushion and pneumatic type, in which the road-engaging surface is in the form of a cushion tire. Patent 1556450. J. Makant, Box 13, West Haverstraw, N. Y.

REFLECTOR.—Including a movable shield, operable by the driver for modifying the light rays of headlights, whereby glare is eliminated. Patent 1557277. J. R. Stoney, Box 83, Ouachita, La.

CUSHION TIRE.—In which the maximum amount of resiliency will be had under the strain of a heavy or a light load. Patent 1557324. S. Pestunowitz, 58 Hillside Place, Newark, N. J.

HEADLIGHT.—Supported to turn with the steering wheel so that the rays of light will be projected directly in advance of the automobile. Patent 1558343. G. Cook, Gillett, Wis.

Designs

DESIGN FOR A HAND BAG.—Patent 68334. H. Margolin, 1237 Broadway, New York, N. Y.

DESIGN FOR A CHILD'S COAT.—Patent 68404. Maude Siegel, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A DRESS.—Patent 68405. Maude Siegel, c/o Franklin Simon & Co., 38th St. & Fifth Ave., New York, N. Y.

DESIGN FOR A RING.—Patent 68378. H. G. Kaufman, c/o Milton Weinberg, 1440 Broadway, New York, N. Y.

DESIGN FOR A FILM REEL.—Patent 68397. B. Petrowsky, c/o Paragon Auto Parts Co., 506 W. 53d St., New York, N. Y.

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